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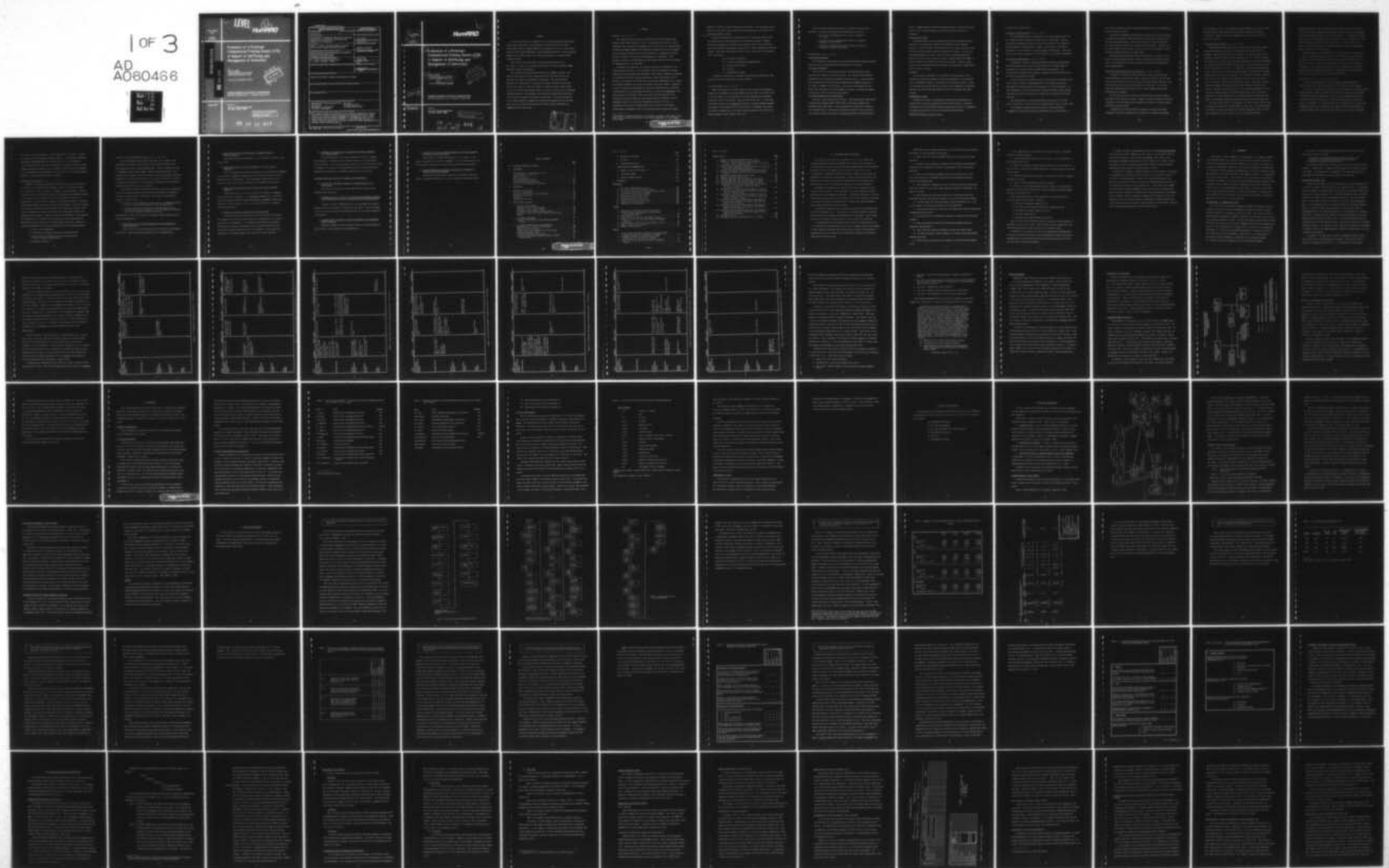

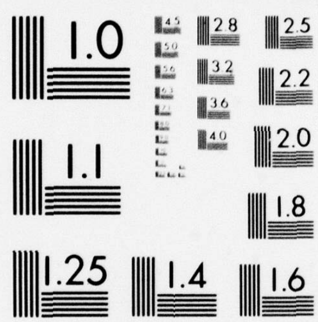

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Evaluation of a Prototype Computerized Training System (CTS) in Support of Self-Pacing and Management of Instruction

by

Robert J. Seidel,
Richard Rosenblatt, Harold Wagner,
Russel Schulz and Beverly Hunter

(Contract No. DAAB09-77-C-0010)

HUMAN RESOURCES RESEARCH ORGANIZATION
300 North Washington Street • Alexandria, Virginia 22314

August 1978

Prepared for

U.S. Army Training Support Center
Fort Eustis, Virginia 23604

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This report contains an evaluation of the prototype Computerized Training System (CTS), sponsored by the Department of the Army and the U.S. Army Training and Doctrince Command (TRADOC) and implemented at the U.S. Army Signal Center and Fort Gordon (USASC&FG). The methodology involved a "lessons learned" approach and includes guidance for future implementation of computer-based training systems.

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PREFACE

This report contains an evaluation of the prorotype Computerized Training System (CTS), sponsored by the Department of the Army and the U.S. Army Training and Doctrine Command (TRADOC) and implemented at the U.S. Army Signal Center and Fort Gordon (USASC&FG). The methodology involved a "lessons learned" approach and includes guidance for future implementation of computer-based training systems.

The study was performed under the direction and supervision of Dr. Robert J. Seidel, Vice President and Director of Eastern Division, Human Resources Research Organization.

The research was supported under Contract No. DAAB09-77-C-0010. The COTR for this project was H.A. Musselwhite, Chief, CTS Field Office, who provided both support and substantive assistance. The authors greatly appreciate Mr. Musselwhite's assistance and overall evaluation efforts and those of Mr. Frank E. Giunti, Mr. Donald A. Kimberlin and Mr. Bryan Altman, of the U.S. Army Training Support Center, Ft. Eustis, Virginia, who contributed valuable historical, developmental, and technical information and assistance to the authors throughout the conduct of the Project. We are also grateful to Ms. Judith Pumphrey of HumRRO for organizing and summarizing the time log data, and to Mr. Michael Hillelsohn who provided valuable assistance in summarizing the attitude data.

SUMMARY

PURPOSE *(see pp. 1-4)*[1]

The purpose of this study was to evaluate the prototype Computerized Training System (CTS) located at the U.S. Army Signal Center and Ft. Gordon (USASC&FG), and to provide the Department of the Army (DA), U.S. Army Training and Doctrine Command (TRADOC), and individual training directors with guidance on the training, technical, and cost-effectiveness of computerized training systems in support of self-pacing and management of instruction. This guidance is based on the data gathered, and lessons learned from the prototype CTS implementation at the USASC&FG.

Throughout our evaluation, the central focus was on information of the "lessons learned" variety. Only information that can be applied to further planning and decision-making was addressed. We felt that a summative evaluation of training effectiveness was not appropriate at this time because the CTS system is a prototype, the courses were only recently implemented at Ft. Gordon, and suitable summative-type student performance data were lacking. Apparently a lack of communication regarding the evaluation implications of a prototype system resulted in the expectation by some of the users that comparative data analyses would be performed. While this would have been desirable in an operational setting, comparative data analyses cannot be expected to yield meaningful results in a prototype implementation such as this one. A comparison of alternative training systems on the basis of costs and/or effectiveness is meaningful only if the systems contain courses with similar

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[1] Page numbers in parentheses refer to the relevant sections in the body of this report where a detailed discussion of the points highlighted in this Summary can be found.

objectives, content, testing conditions, and criteria. The self-paced and CTS versions of the three courses selected for implementation did not meet all of these comparability criteria.

Evaluation questions to be addressed in this study were selected from the Operational Test Plan devised by the CTS project personnel. Highest priority was assigned to answering those questions which could provide the most useful guidance concerning the application of future computerized training systems. There were five general areas of concern covered in this evaluation study. These were:

(1) CTS Course Development

(2) CTS Course Administration and Operations

(3) Training Effectiveness

(4) CTS Costs

(5) Implementation Issues

In addition, evaluation of technical effectiveness was based upon data previously collected and reported in other studies.

CTS BACKGROUND *(see pp. 5-21)*

While the inception of the CTS project can be traced to the feasibility studies at Ft. Monmouth in the late 1960's and early 1970's, the actual start of the CTS project can be identified as the date proposals from potential contractors were to be received. That date was 16 July 1973. At that time, the primary purpose of the prototype system was to provide computer-assisted instruction at the Signal School, located then at Ft. Monmouth, New Jersey. The project personnel were to be those already included on the staff at the Product Manager's Office (PMO) at that site.

Among the events following the project's inception which were most important in affecting the progress and achievements of CTS were:

- The shift in implementation site from Ft. Monmouth to Ft. Gordon,
- the shift in its primary purpose from CAI to computer-managed instruction (CMI),
- the shift in emphasis from field testing a prototype to evaluating an operational system.

METHODOLOGY *(see pp. 23-30)*

Technical Effectiveness

Our findings and conclusions were derived from previous technical reports that evaluated the hardware/software components of the system.

CTS Course Development

The data used for answering the specific evaluation questions were gathered from a number of different sources. One source was questionnaires administered to instructional programmer personnel by CTS. A second source was an extensive structured interview administered by HumRRO personnel at Ft. Gordon to augment the CTS surveys. Also, data were gathered from the weekly time logs kept by course development personnel to document the amount of time spent on CTS instructional development.

CTS Course Administration and Operations

The three courses selected for CTS were: Field Radio Repair (MOS 31E20), Teletypewriter Equipment Repair (MOS 31J20), and Avionics Communication Equipment Repair (MOS 35L20). Data were gathered on instructor activities and responsibilities, content and prerequisite structure of each course and its component annexes, and manual and computer-generated student and course

records. HumRRO personnel reviewed questionnaire data, conducted interviews with the staff, studied documents and acquired hands-on experience as "students."

Training Effectiveness

Performance data on the CTS graduates and self-paced graduates (where feasible) were obtained and transmitted to HumRRO by CTS and USASC&FG personnel. Student records contained ACB entry test scores, education data, and the dates when trainees began and graduated each course. Secondly, we obtained performance data down to the Task level, including progression indices, POI hours, actual instruction hours, absentee hours, and number of failed attempts on the EPIS[1] test for each of the Tasks. Finally, student attitude data were obtained from CTS students on questionnaires administered before and after training.

CTS Costs

CTS cost data, maintained for Fiscal Years 1973 through 1977, were organized and analyzed according to capital, developmental, and operational costs for hardware, software, courseware, and evaluation activities. These data included civilian and military personnel costs, augmented by information gathered from the CTS time logs related to faculty development and staff training.

Implementation Issues

Information related to implementation problems and achievements was obtained from structured interviews and side-effects surveys. The latter instruments provided information regarding unanticipated project consequences or outcomes not covered in the other questionnaires/interviews.

[1] Evaluation Planning Information Sheet

FINDINGS AND CONCLUSIONS

Technical Effectiveness *(see pp. 32-37)*

The CTS hardware/software configuration of six minicomputers with 128 CRT terminals was not designed for optimal use as a CMI system. Some key instructional management functions are not being supported, even though the current hardware is underutilized. However, one or more of the Display Controllers could be modified to directly support CMI functions. Only after this is done could an analysis of its CMI utility to Ft. Gordon be performed.

CTS Course Development *(see pp. 38-63)*

A systematic, iterative course development process was followed which included document review, subject-matter selection for various means of presentation, and flowcharting of student/system interactions. The Instructional Programmers then prepared, evaluated, and revised the on- and off-line course content and logic.

On-line materials accounted for 11.7% of the POI hours contained in the three courses. However, approximately 65% of the 55,000 instructional development hours was devoted to the preparation of on-line materials. On-line development activities consisted of original authoring, review, debug, and revision rather than conversion or modification of existing self-paced materials.

The average number of course development hours per hour of on-line instruction for all courses was 175; the range was 144:1 (35L) to 197:1 (31J).

No systematic procedures were articulated by the Instructional Programmers for identifying specific problem areas in the instruction or

for correcting material based on formal feedback sources (e.g., CTS-generated reports or manual records).

Instructional Programmers reported that no difficulties were encountered in fitting the previously developed self-paced instructional materials into the CTS instructional model. They also felt that the CTS system enhanced the effectiveness and efficiency of instructional validation. However, the IP's were divided on how difficult it was to follow the CTS review/revision process in making revisions in a timely manner.

Inputting training materials on-line was hampered by a number of acute system hardware/software problems in which stored materials were lost, slow-down of the debug/revision process occurred, and delays were experienced in course implementation.

<u>CTS Course Administration and Operation</u> *(see pp. 64-89)*

In general, CTS generated reports that were used by instructors and training managers were favorably viewed. However, only 20% of the IP's knew about a set of reports that could be used for course revision purposes. Thus, these reports were not used in spite of their availability. On the other hand, most personnel were familiar with the reports dealing with student scheduling and throughput.

The CTS was also seen as effective in monitoring and routing students from Task to Task through the course. However, instructor opinion was divided on whether or not CTS reduced their workload in the areas of routing students and keeping related records.

It appeared that CTS had sufficient resources to handle the student throughput during this implementation, inasmuch as no significant queueing

was experienced. Also, if the computer became inoperative, there were enough back-up materials and instructor time available to provide the needed instruction. (This proved to be no problem, as less than 12% of the POI hours were on-line.)

Training Effectiveness *(see pp. 90-108)*

Training effectiveness data indicated that CTS and self-paced students progressed through the courses on the average about as fast as the POI demanded. However, there were some variations. In the 31E course, the CTS progression index (PI) was 1.11; the self-paced was .84. In the 31J course, the average PI for CTS was 1.01; self-paced ranged from .98 to 1.08, depending upon the particular POI in effect at that time. In the 35L course, both the CTS and self-paced PI was .96. It is important to note several limitations on any conclusions to be drawn from these findings. The CTS courses included pretests and/or posttests not included in the self-paced versions. Therefore, the total time, by definition, included more material in the CTS version than in the other. Also, POI hours varied over time. Thus, there were many Tasks with different POI hours in the CTS and self-paced versions of the courses. Although, theoretically, PI's can be compared independently of POI hours, such changes might have reflected substantive content alterations. The effects of these modifications on training time are not known and, thus, hinder any meaningful comparisons between CTS and self-paced training time.

The total failure rate of CTS students in the 31E course in FY 1977, and in the period October 1977 to March 1978, was about 11%. In the 35L course, the failure rate from July 1977 to May 1978 was approximately 12%. No data were available on the 31J course, as it was still being validated.

Available performance data indicated that CTS students passed the Task test on the first attempt somewhat more frequently than did the self-paced students. The data are limited, however, and are only suggestive. Correlational analyses showed positive relationship between the number of times a student had to take the CTS administered Task EPIS tests and the time to complete instruction. This is apparently based upon the required remedial sequences following Task EPIS test failure in the CTS courses.

Student responses to an attitude survey revealed more of a dislike than a liking for this particular instructional mode. They felt the instruction was too hard, the instructors less available than they should be, and the variety of media were difficult to work with. They were also influenced by the degree of system down-time and the shortage of terminals, all of which they perceived as impeding their learning. Two-thirds of the students said they would not prefer more instruction delivered by CTS.

<u>CTS Costs</u> *(see pp. 109-112 and 132-135)*

CTS cost data indicated that the total amount expended during the period FY 1973 to FY 1977 was estimated at $7.5 million (in 1977 dollars).

As one of our study goals, we were to perform a predictive cost-effectiveness analysis of CTS. However, insufficient operational cost data were available to make any valid cost predictions. Also, no direct comparison between the CTS and the self-paced courses was possible since the costs for the latter were not calculated. It is possible that with a modification to the existing software and hardware configuration, the current CTS system could handle an on-board training load of 6,000 to 8,000 students at Ft. Gordon. This would

be the case if the system were to be used entirely in a CMI mode. In order to perform a cost-effectiveness analysis, however, the necessary additional courseware/software/hardware costs would first have to be calculated. A careful analysis needs to be done to determine the additional software and/or hardware necessary to handle all of Ft. Gordon's self-paced course management by CTS and whether the extra expense is less than that of a comparable manual operation. Only then can this issue be resolved.

<u>Implementation Issues</u> *(see pp. 113-121)*

A number of critical management decisions made early in the CTS project are related to its implementation problems. First, the decision was made not to delay the project in spite of a change in site and purpose. Secondly, a computer literacy training program was not undertaken with USASC&FG personnel at all levels after the change in site was accomplished. Thirdly, the establishment of a dual chain of command at the USASC&FG resulted in ambiguous relationships between the CTS project and School personnel. Fourthly, hardware and software instability as late as January 1977 should have delayed on-line course development and student interactions until subsequent stability and reliability were obtained. However, no delays were requested. These findings were supported by the results of the side-effects survey (administered in 1976 and 1977) which yielded the following negative reactions. Namely, the premature implementation of CTS was associated with the following problems:

- Lack of clear management.
- Instability of hardware, software and course materials.
- Lack of adequate training for instructional personnel related to computer-based training.
- Personnel turbulence.

LESSONS LEARNED/RECOMMENDATIONS *(see pp. 134-142)*

Is the CTS adequate for the Army's CMI needs at Ft. Gordon or any other Army installation? This question is not answerable based on the data available from the current implementation. Both the CSSEA (1977) and the COMTRAINS (1978) reports suggest that with some modification to the software and the hardware links, the current system could provide sufficient capability for all CMI needs projected at Ft. Gordon. Whether or not CTS is or would be cost-effective in this capacity will depend on the alternative systems against which it is to be compared.

The following statements describe the lessons learned in our evaluation of CTS and provides guidance to those who may be planning to implement an innovative training system. Essentially, these lessons learned can be reduced to two main points:

(1) There must be an unambiguous, single chain of management/authority vested in an integrated component of the targeted school.

(2) A certain sequence of development and implementation must be followed with a prototype system in order for adequate conclusions to be drawn regarding training effectiveness.

The remainder of this section details the guidance deemed appropriate for a prototype implementation.

- Insure that there is universal agreement (or understanding) on project purpose(s).

Project staff and user expectations must be clarified and documented by consistent, coherent planning agreements prior to implementation.

- <u>Make certain that the system design is compatible with the project purpose(s)</u>.

The hardware/software requirements for a CAI system are different than those for CMI.

- <u>Insure that there is a serial development of critical system Components</u>.

First, the hardware and software designs must be developed and implemeted to a point where <u>reliable</u> and <u>stable</u> outputs are provided without any actual course materials on the system. Course development should proceed on the system only after the testing and debugging of the hardware and software.

- <u>Employ an evaluation model that is consistent with the project purpose(s)</u>.

Determining whether or not the evaluation is formative or summative will <u>focus</u> the data collection. In a <u>prototype</u> implementation, a formative process is needed, involving iterative development, debugging, testing, and revision of course materials. Only in an operational mode is a summative evaluation appropriate.

- <u>Employ a staffing mix consistent with project needs</u>.

An interdisciplinary team approach such as that used in CTS should be continued in the future, and the mix should be appropriate to the type of project that is implemented. If a comparative evaluation is to be made, there should be dedicated staffing provided to collect data from all the alternative training systems that are to be compared. In the case of the CTS project, not enough resources were allocated to these functions.

- Permanence of key personnel is essential for timely completion of a complex project.

It is particularly critical that turbulence be held to a minimum when attempting to implement such a complex innovation as computer-based training systems. Loss of key personnel, such as was the case with CTS, cannot be tolerated. In the future, the Army would do well to provide sufficient extensions of duty tours to accommodate completion of such projects.

Training Site/Project Interface: Managing the Implementation

- Literacy and orientation programs are required prior to site installation.

The users at the target site must understand the nature of the computer-based innovation.

- Commitment, lines of control, and participatory management involving the designated user site must be established prior to installation.

A degree of control commensurate with the involvement and required support from the site should be provided from the outset. This is necessary in order to prevent the system from being perceived as an outside imposition on the School.

- A single chain of command for project management at the designated site is necessary.

The Project Manager's Office should be located at the implementation site in order to avoid ambiguities in communication.

- Integrate the chain of command (management) within the training directorate of the user's site.

There should be a single individual who is in control of the project responsible to the School commandant. This individual should also be charged with and given the authority for instructional development.

- Frequent meetings are necessary to monitor the atmosphere of expectation and understanding.

Coordination of team effort, expression of problems, adhering to various contingent deadlines, etc., require regularly scheduled meetings.

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A. EVALUATION OBJECTIVES/PURPOSE

The purpose of this study was to evaluate the prototype Computerized Training System (CTS) located at USASC&FG and to provide the Department of the Army (DA), U.S. Army Training and Doctrine Command (TRADOC), and individual training directors with guidance on the training, technical, and cost-effectiveness of computerized training systems in support of self-pacing and management of instruction. This guidance is based on the data gathered, and lessons learned from the prototype CTS implementation and operational test and evaluation at the U.S. Army Signal Center and Ft. Gordon (USASC&FG).

Throughout our evaluation, the central focus was on information of the "lessons learned" variety. Only information that can be applied to further planning and decision-making was addressed. A summative evaluation of training effectiveness was not timely due to the fact that the CTS system is a prototype, the courses were recently implemented at Ft. Gordon, and suitable summative type student performance data were lacking.

An extensive evaluation plan was included as part of the Operational Test Plan (OTP) [September 1975]. As a result, a considerable number of questionnaires and survey instruments were developed by CTS personnel. When we began our study, we decided to select the most critical topics for evaluation.

In coordination with CTS personnel and the COTR, we assigned priorities to the evaluation questions described in the OTP. Highest priority was assigned to those evaluation questions which could provide the most useful guidance to training directors with respect to the application of advanced technology to computerized training systems.

These high priority evaluation questions are listed below and are addressed individually in other Sections of this report.

1. What is the CTS course development process for off-line and on-line materials?

2. How much time is required to prepare the training and test materials contained in the operational self-paced course Annexes to CTS instructional materials?

3. What is the average development time (hours) required for one POI hour of instruction in the Computer Assisted Instruction/Computer Managed Instruction (CAI/CMI) mode?

4. What feedback is available for use in revising instructional materials and tests? How has it been used? What additional feedback is necessary? How would it be used?

5. What difficulties have been encountered in fitting the previously developed self-paced instructional materials into the CTS instructional model?

6. To what extent does the system enable timely modification (e.g., due to POI changes), revision and validation of course materials?

7. What special problems, if any, were encountered when entering (inputting) training materials on-line?

8. How useful are the CTS-generated reports for instructors and training managers?

9. Has the system been effective in monitoring students within the respective Tasks/Annexes?

10. Were sufficient resources available to handle the student load?

11. Is there an adequate back-up capability to provide instruction during computer down-time?

12. What special qualifications are required by the instructional support staff?

13. What administrative and personnel costs were incurred to establish in-service training programs?

14. What unanticipated side effects or by-products can be attributed to the implementation of CTS?

15. What is the average student progression index by Task and Annex for each CTS course? What is the standard deviation? How many graduates were there in each course?

16. What was the number and percentage of students who failed to graduate from each CTS course?

17. What are student attitudes towards CTS courses?

18. What is the relationship between student scores on CTS administered task tests and Progression Index values? What percentage of students passed CTS tests on the first try?

These evaluation questions can be grouped into five general areas of concern in this evaluation study. These are:

- CTS Course Development (Questions 1-7)
- CTS Course Administration and Operations (Questions 8-11)
- Training Effectiveness (Questions 15-18)
- CTS Costs (Question 13).
- Implementation Issues (Questions 12 and 14)

Also, cost data other than that required by Question 13 were gathered to determine the total costs of CTS. These costs were used to support the cost-effectiveness projections that were part of our required effort.

In addition to the questions listed above regarding CTS implementation, we focused our evaluation efforts on other implementation issues that must be considered when incorporating innovative instructional systems such as CTS into operational training environments.

No attempt was made to independently evaluate the technical effectiveness of the hardware/software components of CTS. Rather, we used data previously collected and reported in other projects (COMTRAINS, 1978; Report on the Performance Measurement and Analysis of Project ABACUS (U.S.A. CSSEA, 15 April 1977; Hunter, 1976) to identify and discuss the system's hardware/software components as they related to our major areas of concern.

The ability to evaluate a complex system such as CTS requires the evaluator to be cognizant of the forces and events that led to the system's status at the time it is being evaluated. Ideally, the evaluator should have been directly involved from the start of the project, determining which data are to be collected, how they are to be collected, etc. In the case of CTS, HumRRO staff have had an intimate knowledge of the project from its inception, but were not directly involved in formative data collection policies or procedures. It was necessary, then, to reacquaint ourselves with the history of CTS, its progress to date, and thereby attempt to understand the context within which the evaluation data were collected. Selected aspects of this project's history will be presented and discussed in the following section.

B. BACKGROUND

The history of Project ABACUS, as it became known (or the Army's Computerized Training System), has its roots in the feasibility studies conducted by the US Army Signal Center and School (USASCS) at Ft. Monmouth, New Jersey. The interest in CTS started in 1966, with the Technical Development Plan submitted to the Director, Defense Research and Engineering. An initial feasibility study was conducted in late 1967 utilizing a small segment (11.25 hrs) of Common Basic Electronics subject matter. The follow-up study which began in June 1968 and concluded in December 1971 was oriented toward demonstrating the viability of CAI utilizing a larger segment (102 hrs) of Common Basic Electronics as the test subject matter on the IBM-1500 Instructional System. The results of this particular study supported the notion of a 30% or more savings in training time over conventional instruction; and it also indicated a reduction in attrition possible on the order of 20 to 21% using CAI.

The Beginning: Ft. Monmouth Test Site

As a result of the successful experience at USASCS, Ft. Monmouth, the Department of the Army, through the Management Information Systems Directorate, became interested in a potential Army-wide use of CAI. As a result of this, a Task Group was established to examine the possibility of the use of CAI in technical training throughout the Army. The Task Group Report prompted the Vice Chief of Staff of the Army to issue a Project Implementation Letter (see Attachment 1). This led to the establishment on 1 August 1972 of a project for the design and development of a prototype system. (More information is provided in the First Year Annual Report of Project ABACUS, 1 August 1973.) It is significant to note that at that time ABACUS was considered to be a prototype program, Dr. Vincent P. Cieri was designated as the Interim Product Manager.

The nature of Project ABACUS was stated succinctly in the first year's annual report (1973) as follows:

> "The mission of Project ABACUS is to design, develop, test and evaluate a 128-terminal computerized training system utilizing the multi-mini computer concept."

The authorized staffing for the project was 39 spaces, both military and civilian. In August 1972, a permanent Product Manager was appointed, Colonel G. B. Howard. And subsequently, a Department of the Army Steering Advisory Group (SAG) was established to provide guidance for the project.

System Specifications: CAI

During the early months of 1973 (through March), the Product Manager's Office wrote performance specifications for the prototype system. The specifications for hardware and software resulted in a Request for Proposal (RFP) which was initially issued on 18 April 1973. This RFP encompassed operating system software, CAI language design, and hardware components. The course development and evaluation portions of the project, as well as overall management, were to be accomplished within the Army and overseen by the Product Manager's Office. During the initial conceptualization of this project, that is, through March 1973, the system was expected to be established at Ft. Monmouth, New Jersey. The purpose of the system at that time was primarily to provide computer-assisted instruction (CAI). This is reflected by both the RFP and the Operational Test Plan (September 1975). This purpose required the hardware/software to support: interactive, on-line instruction; a significant percentage of graphics authoring and administration; a two-second response time; and other CAI-related requirements.

In response to the RFP (which included 11 amendments between 18 April and 16 July 1973), three proposals were received. The close out date for receipt of proposals was 16 July 1973. It is important to stress again

that those proposals were directed towards meeting the original goal of a CAI system as indicated by the RFP; the site was to be Ft. Monmouth; and the project personnel were to be those already included on the staff at the Product Manager's Office (PMO), Ft. Monmouth.

Since its inception in August 1972 the CTS Project is one of the most well-documented of all computer-based training projects. The CTS staff has produced five annual status reports. Technical evaluation has been reported three times formally (Hunter, 1976; Report on the Performance Measurement and Analysis of the Project ABACUS, 15 April 1977; and COMTRAINS Final Report, 1978). The overall evaluation plan had also been published early in the project (Operational Test Plan, September 1975). In addition to this documentation, personnel from the Communicative Technology Office at Ft. Eustis, Virginia, provided to us a chronology of significant events for the CTS project. We have included this chart as Figure 1 on pp 8-14. With this chart serving as the illustrative framework, we will highlight some of these significant events below.

Shift in Site

The most important event was the shift in implementation site. The CTS project was a prototype computerized training system that involved lashing up six PDP 11/35 minicomputers in a novel configuration to service 128 terminals on a real time basis. The location was originally to be Ft. Monmouth where the Army had acquired prior experience in developing CAI materials and implementing a CAI system. On the other hand, only course development workshops were held for USASC&FG personnel, but no management level computing literacy training was given (Whitehouse, 1 August 1974).

Accompanying the implementation site shift was a shift in purpose of the system from CAI to CMI. This change evidenced itself in attention to management

1972	JANUARY - MARCH	APRIL - JUNE	JULY - SEPTEMBER	OCTOBER - DECEMBER
CTS Project Administration Events		USASCS, Ft. Monmouth, NJ designated CTS Test Site (June)	Start CTS Project (Through June 1978) Project Charter (Aug) Management Plan (Aug) SAG meeting (Sep)	SAG Meetings (Oct, Nov, & Dec)
System Events			HumRRO System Design (Aug-Oct)	TICCIT Evaluation and Specs for Industry Hardware (Oct-Nov)
Course Development Events		Course Development started at USASCS (April)		
Evaluation Events				
Other Events				

Figure 1. Chronology of Significant Events - CTS Project

1973	JANUARY - MARCH	APRIL - JUNE	JULY - SEPTEMBER	OCTOBER - DECEMBER
CTS Project Administration Events	SAG Meeting (Feb)	Closing of USASCS Announced (April) SAG Meeting (May)	SAG Meeting (Aug)	USASESS Ft. Gordon, Ga. Redesignated Test Site (Nov) SAG Meeting (Oct)
System Events	System Concept (Jan & Feb) Survey Industry (Jan) Performance Specs (Feb-April)	RFP to Industry (April-July)	Evaluation of Proposals (Aug-Oct)	Negotiation and Contract Award (Oct-Dec)
Course Development Events			Preliminary Instructional Model (July)	31E-31J-35L Courses Approved for CTS (Dec)
Evaluation Events				
Other Events				

1974	JANUARY - MARCH	APRIL - JUNE	JULY - SEPTEMBER	OCTOBER - DECEMBER
CTS Project Administration Events	MOU Between PM, CTS & Commandant, USASESS Signed (Mar) CTS Field Office established at Ft. Gordon (Feb) SAG Meeting (Feb) Initial Personnel to Field Office (Mar)	SAG Meeting (May)	5 Personnel on Board at F.O. (Aug)	SAG Meeting (Dec)
System Events	System Programmer Training (Feb)	Subsystem to USASCS (April) Communication Study Started (Apr 74-Jun 75)	DC-4 to USASIGS (July) Phase I Acceptance Test run; Software Accepted Hardware Accepted (Aug) Systems & Applications Programming to CTS Field Office (Aug)	
Course Development Events	Course Development started at USASIGS 31E-31J-35L Courses (Feb) USASIGS Task Group Formed (Jan)	35L POI Approved (May)		
Evaluation Events	Preliminary Evaluation Plan for CTS (Jan)			
Other Events				Consultant's Conference (Dec)

Figure 1 (continued) Chronology of Significant Events - CTS Project

1975	JANUARY - MARCH	APRIL - JUNE	JULY - SEPTEMBER	OCTOBER - DECEMBER
CTS Project Administration Events		Field Office Fully Staffed 16 People (May)	PM, CTS move from Ft. Monmouth to Ft. Eustis, Va. (July) 19 Personnel in Field Office (Aug)	
System Events	Phase II Acceptance Test - First Run (Feb) Moran Hall Construction (March-May)	16 Terminal System Installed USASIGS (Apr) Communications Study Completed (April 74-June 75) Phase II Acceptance Test - Second Run (April)	Communications Contract Negotiated (July)	
Course Development Events				
Evaluation Events			Operational Test Plan (OTP) (Sep)	
Other Events		NSIA Conference (June)		

Figure 1 (continued) Chronology of Significant Events - CTS Project

1976	JANUARY - MARCH	APRIL - JUNE	JULY - SEPTEMBER	OCTOBER - DECEMBER
CTS Project Administration Events			16 Personnel On Board in Field Office (Aug)	
System Events	Communications & 128 Terminal System Installed (Feb) Phase III Acceptance Test - 1st Run, Levels 1 & 3 Completed (Feb) RSX 110 Version 6B Operating--System Purchased & Installed to Replace Version 4A (Feb-July) Phase III Acceptance Test - 2nd Run, Level 2 Completed (March)		Phase III Acceptance Test - 3rd Run, Levels 4 & 5 Completed (July)	System Accepted (Oct)
Course Development Events		Validation 31E (April)	31E POI Approved (Jul) Validation 31J & 35L (Jul)	
Evaluation Events				OTP Update (Dec)
Other Events				

Figure 1 (continued) Chronology of Significant Events - CTS Project

1977	JANUARY - MARCH	APRIL - JUNE	JULY - SEPTEMBER	OCTOBER - DECEMBER
CTS Project Administration Events			9 Personnel On Board in Field Office (Aug)	CTS Transferred to TDI (Oct)
System Events				
Course Development Events	Started First Course on System 31E (Jan)	First Student Under CTS Graduates (April) Full 31E Course on System (May) 35L Course Started on CTS (Apr)	31J Course POI Approved (July) Implemented 31J on CTS (Aug) 35L 100% Implemented (Jul)	
Evaluation Events	System Evaluation by CSSEA Completed (March-April)		HumRRO Awarded Evaluation Contract (July)	Data Collection
Other Events	OCR CEP Drafted (Feb)	USASIGS Started OCR CEP for CTS (April)	COMTRAINS Study Final Report (Sep 77 - Jan 78)	

Figure 1 (continued) Chronology of Significant Events - CTS Project

1978	JANUARY - MARCH	APRIL - JUNE	JULY - SEPTEMBER	OCTOBER - DECEMBER
CTS Project Administration Events		CTS Project Ends (June)		
System Events				
Course Development Events				
Evaluation Events	Data Collection	Data Collection	Final Report	
Other Events	COMTRAINS Study Final Report (Sep 77- Jan 78)			

Figure 1 (continued) Chronology of Significant Events - CTS Project

functions (scheduling, graduation prediction, recordkeeping and reporting) with interactive on-line instruction be relegated primarily to pre- and post-testing.

Three USASC&FG courses were selected for evaluation of the prototype CTS in a school environment. The courses were self-paced and were presented in a computer-managed instructional mode (CMI) by the Army's prototype CTS. The three courses are: Field Radio Repair (MOS 31E20); Teletypewriter Equipment Repair (MOS 31J20); and Avionics Communication Equipment Repair (MOS 35L20). For sake of brevity, the courses will be referred to as 31E, 31J and 35L.

Subsequent to the shift to Ft. Gordon, the fourth year report on the CTS Project noted that "all of the personnel originally assigned by USASIGS to the project were replaced at least once" (Kimberlin, 1 August 1976). This highlighted a continuing problem of personnel turbulence. As a result, there was a loss of key software personnel, and administrative and management changes not originally foreseen. There was a shift in the relationship between the project structure and the school structure when the site was shifted from Ft. Monmouth to the Southeastern Signal School at Ft. Gordon, Georgia. That shift occurred in November 1973, although it was known as early as April 1973 that there would be the shift. Thus, knowledge of the shift was available prior to the Bidders' Conference on 4 May 1973. It is also significant to note that the contract was not awarded for development of the system until December 1973.

A summary of the events which occurred related to procuring the system for Ft. Gordon is given in the Third Year Status Report on the CTS Project (Kimberlin, 1 August 1975, p. 2). These events are as follows:

1. April 1973: RFP issued to industry.
2. December 1973: GTE Sylvania awarded the contract.
3. April 1974: Initial computer system delivered to Product Manager's Office.

4. July 1974: Initial 32-terminal display controller delivered to USASIGS.

5. May 1975: Full six-processor, multi-mini computer system delivered and installed with 16 terminals. One hundred and twelve terminals placed in local storage.

6. June 1975: Communication study completed.

7. July 1975: Communication and cabling contract negotiations.

8. July 1975: FY76 maintenance of CTS contract negotiations.

The following paragraph from the same report elaborates on some other changes that took place as a result of the project's shift to Ft. Gordon.

> The project as initially planned for implementation at USACES Ft. Monmouth, New Jersey, was to be colocated in one building with the three selected courses. The consolidation of the Army Signal School at Ft. Gordon, Georgia, has resulted in the computer system being located in the building separate from two of the courses selected at the USASIGS Ft. Gordon, Georgia. The computer system is located in Moran Hall, with terminals located in Moran Hall, Brant Hall and Greely Hall. This has increased terminal communication requirements relative to cabling, and the electromagnetic environment not planned in the original installation. To date, a study has been made and it has been determined that: subterranean cable construction is required between buildings, since there is no existing ductwork available; and, amplifiers and isolation transformers are required to stablize the signal circuits between the computer and the remote terminals. The results and recommendations of the study have served as the basis for the following on-going actions:
>
> (a) Modifying of the original GTE-Sylvania contract.
>
> (b) Obtaining the necessary funding required.
>
> (c) Negotiating the contract changes with GTE-Sylvania and US Army Computer Systems Support and Evaluation Agency (CSSEA).
>
> (Kimberlin, August 1975, p. 3)

Course Development

Significant events relating to course development also occurred as a result of the change from Ft. Monmouth to Ft. Gordon. Three courses were chosen for CTS implementation by the Commandant of USASIGS (Whitehouse, 1 August 1974). These courses were already self-paced and had achieved a 30-35% reduction in course completion time. In order to achieve additional significant training time savings, a CMI approach would have had to be tailored to the needs of those specific courses, i.e., be problem-oriented. Also, there was a need to establish a field office at Ft. Gordon, and this led to a further set of problems related to delays in course development in this new operational setting. It should be noted that as the chronology chart indicates, course development work at Ft. Gordon started in February 1974, yet the system's hardware and software were not accepted until October 1976. This is a reversal of what one should expect in implementing a prototype computer-based training system.

Revisions to the programs of instruction meant that lesson materials that had been prepared earlier had to be revised (Kimberlin, 1 August 1975). Other related problems in lesson material preparation occurred with the loss of time in site preparation for the 128-terminal system at Ft. Gordon; revision of the data file structure; and the need to have reliability of the system improved at Ft. Gordon after it was moved from the contractor's facility. It should be noted, however, that in spite of all the delays caused by the site shift, no request for a delay in project completion was made to higher headquarters.

Project/School Relationship

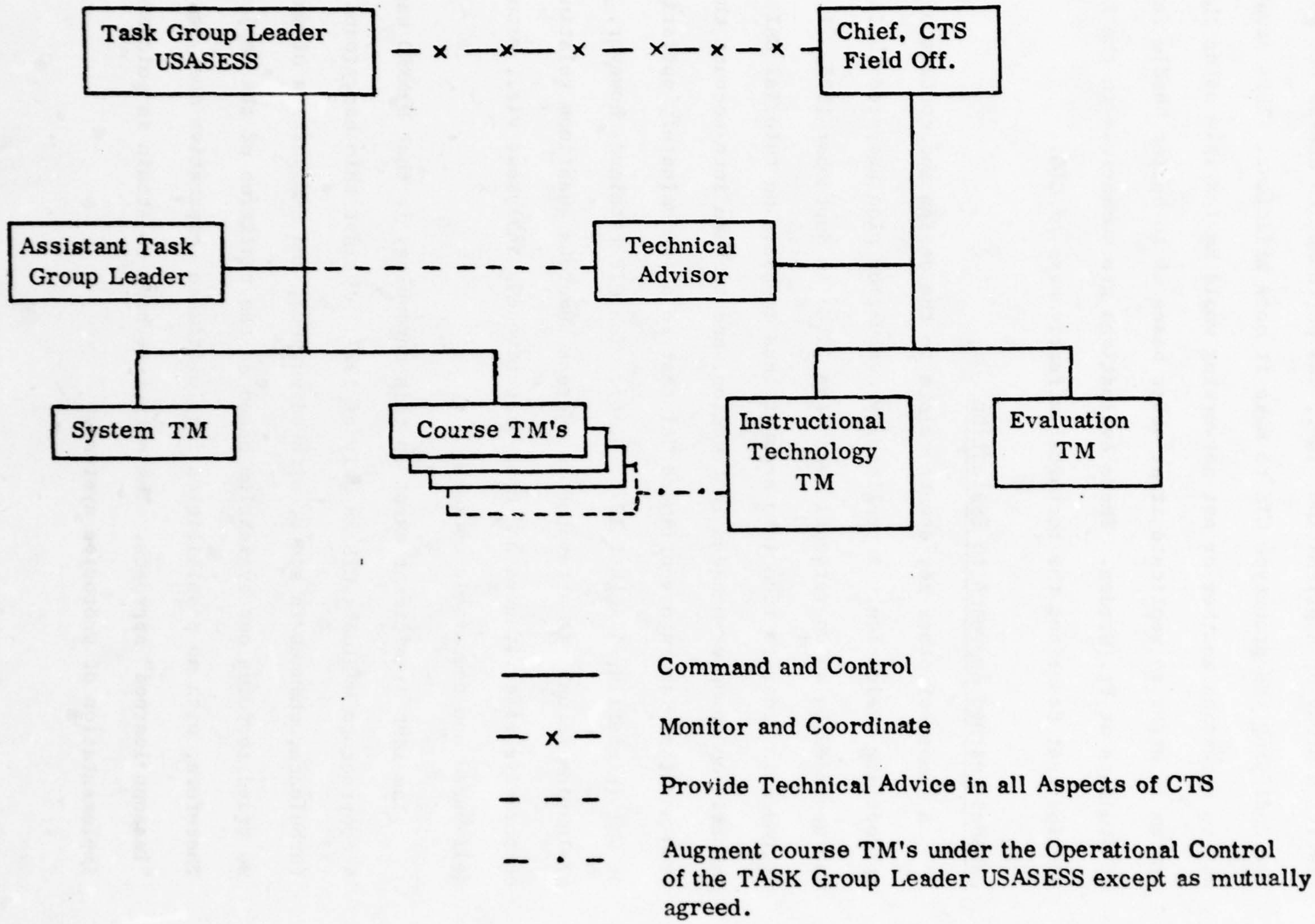
Another significant event in the history of this project concerns the administrative arrangement between the CTS field office staff and the Ft. Gordon Signal School staff. Course teams were created for course development at Ft. Gordon to allow cooperation between the field officer personn l and the School personnel. A Signal School Task Group was created for school responsibilities. A CTS Field Office group retained local project management responsibilities. There resulted from this arrangement a dual-ladder of responsibility (see Figure 2). The USASC&FG/CTS Field Office cooperative relationship occurred through voluntary actions and at a very low organizational element within the School. This isolated the project from the School policy and decision makers by several layers of management.

Hardware/Software Evaluations

Establishment of an Acceptance Test Plan under contract to HumRRO during the early part of 1974 signifies another milestone in the history of CTS. The actual acceptance testing began in July 1974, under a three-phased process. The Phase I acceptance test was accomplished in August 1974, during which time the hardware and the operating system software was accepted. The Phase II acceptance test was begun in February 1975. The system at that time failed the second phase of the test. It was re-run in April 1975 and was passed at that time. Phase III acceptance testing was begun in February 1976, and was not completed until July 1976. There were a number of difficulties with the operating system, its response time and in simulating full loads on the system. However, the system was fully accepted on a second run in October 1976.

In addition to this acceptanct test, there was a simulation run by CSSEA to test out the technical effectiveness of the system. The entire technical

Figure 2. Operational Test and Evaluation Organizational Relationships SESS/CTS



(Whitehouse, 1 August 1974, p. C-7)

evaluation was not completed by CSSEA until the period January - March 1977. Lastly, a study by Appli-Mation, Inc., was performed to assess the possibilities for modifying the prototype CTS to make it more efficient. This study also was to determine whether or not networking would be feasible using the current system in order to replicate it at other bases or to better handle full loads of students at Ft. Gordon. These evaluations are summarized in the Results Section that describes the technical effectiveness of CTS.

Lessons Learned Approach to Evaluation

A number of other key events relate to the design and conduct of an appropriate evaluation. A preliminary evaluation plan prepared in January 1974, was upgraded to an Operational Test Plan (OTP) in September 1975. It was upgraded in order to take into account less emphasis on tutorial CAI and new emphasis on computer-managed instruction, and to take into account the shift from a rather laboratory-oriented CAI test to a predominately operational test of CMI (Kimberlin, 1 August 1975, p. 6). The OTP retained, however, a summative evaluation focus. It attempted to address numerous questions relating to comparative effectiveness and cost-effectiveness analyses; viz., manually self-paced and comparable courses.

The last significant event in this chronology is that HumRRO was awarded a contract to evaluate CTS in July of 1977. Against this background of turbulence, changes in scope, altered purpose, and ambiguities of management, we tried to focus our evaluation based on the realities of the implementation. Therefore, with no possibilities for legitimate comparative analyses, we took a "lessons learned" approach. The output we hope to attain is guidance for future implementation of prototype systems.

The data collection on the project ended in December 1977, yet all three courses upon which the evaluation was to be based had not been completed. In fact, one course, the 31J Teletypewriter Equipment Repair Course, was still not completely implemented on the CTS system until May 1978, because of extensive POI changes. As noted earlier, a prototype implementation such as CTS can only legitimately include a "lessons learned" type of evaluation. Any comparisons between CTS and self-paced versions of the courses can be made only on a preliminary basis. Findings should be used only as suggestions for future modifications to the CTS system and to derive guidelines for valid comparisons to be attempted subsequently in the operational implementation of this system.

The next section--Methodology--describes our approach to gather the evaluative information needed for our study.

C. METHODOLOGY

This section describes the sources of data used in answering the evaluation questions; the personnel involved at Ft. Gordon and Ft. Eustis in collecting these data; and the methods employed in obtaining and analyzing the data. The following paragraphs are organized in terms of the areas of concern in our evaluation.

Technical Effectiveness

These findings were obtained from reports that evaluated the hardware/software components of the system.

CTS Course Development

A description of the process involved in developing CTS instructional materials for all three courses was obtained from CTS documents that specify the activities that instructional programmer personnel were to follow when preparing course materials. These were supplemented by interviews with instructional programmer personnel at Ft. Gordon.

Data related to answering specific evaluation questions within the course development area came from several different sources. One such source was questionnaires selected from the large number administered to instructional programmer personnel by CTS. The specific survey questionnaires used in this part of the evaluation are: (1) The CTS Course Materials Development Survey (Attachment 2), and (2) the Revised and Alternate Training Materials Survey (Attachment 3).

A second source of data for questions regarding the course development process was an extensive structured interview (Attachment 4) administered by HumRRO personnel at Ft. Gordon to augment data obtained from the CTS Surveys.

The structured interviews were administered during the periods 13-17 February, 1978 and 20-24 February, 1978, to 23 instructional programmer and management personnel at Ft. Gordon. The structured interviews obtained additional information for each course on how much time was devoted to developing on-line and off-line CTS materials, the amount of material developed, and problems encountered by personnel during these activities. Tables 1 and 2 list the personnel interviewed, their titles, and the course administrative component to which they belong.

A third source of data is the weekly time logs kept by course development personnel to document the amount of their time spent in each of the components of the instructional development process for CTS. These logs for the period 1974 to 1977 were transmitted to HumRRO where the data on each individual for each course were summarized and tabulated. A copy of the instructional development time log in shown in Attachment 5.

CTS Course Administration and Operations

Detailed information of the organization, content, and instructional process in the CTS versions of the 31E, 31J and 35L courses was gathered in October and November of 1977 by HumRRO personnel visiting the Signal School. Interviews with the staff, study of documents and "hands-on" experience as "students" provided the data necessary for thorough documentation of instruction, remediation, and testing procedures for both on-line and off-line activities. In addition, data were obtained on instructor activities and responsibilities, content and prerequisite structure of each course and its component annexes, and manual and computer-generated student and course records. The data were organized and are presented in a narrative description in the Results section. Other instruments used to answer the appropriate evaluation questions related to this area of concern include the:

Table 1. Instructional Programmer Personnel Interviewed during Data Collection, Ft. Eustis and Ft. Gordon

Name	Title	Course
C. Lewis	Instructional Programmer/Team Leader	31E
SFC Wood	Instructional Programmer/Instructor	31E
SFC Visser	Instructional Programmer/Instructor	31E
W. Whitaker	Instructional Programmer/Team Leader	31E
*J. Lamb	Instructional Programmer/Education Specialist	31E/35L
F. Huggins	Instructional Programmer/Instructor	31J
SFC Megginson	Instructional Programmer/Instructor	31J
R. Bury	Instructional Programmer/Instructor/Team Leader	31J
*SFC Hooker	Instructional Programmer	31J
Mr. Singleton	Training Specialist	35L
SFC Howard	Instructional Programmer/Instructor/Team Leader	35L
E.B. Wilkins	Instructional Programmer/Team Leader	35L
*B. Altman	Instructional Programmer/Educational Specialist	31J
*H.A. Musselwhite	Instructional Programmer/Educational Specialist (EVAL)	
*D.A. Kimberlin	Technical Advisor/Educational Specialist	

*CTS Field Office Personnel

Table 2. Management Personnel Interviewed during Data Collection, Ft. Eustis and Ft. Gordon

Name	Title	Course
Mr. Bush	Chief, Communications/Flight Line Division	35L
MSGT Thomas	NCO/Chief Instructor	35L
MSGT Turner	NCO/Communications/Flight Line Division	35L
Mr. Cooper	Training Supervisor/Course Supervisor	31E
Mr. Dickson	Chief, Radio Repair Division	31E
Mr. Moore	Division Chief/TTY Repair	31J
LTC Campbell	Department Director/Communications Section	31E/31J
LTC Westbrook	Director, Radio Department	31E
Russ Watkins	Shift Supervisor/Data Systems Division	
Bob Stephens	Chief,Data Systems Division	
John White	Training Spec./Data Systems Division	

(1) Operational Reports Survey (Attachment 6)

(2) Resource Allocation Survey (Attachment 7)

(3) Instructional Process Survey (Attachment 8)

Training Effectiveness

Data on training effectiveness were represented in the form of performance data on CTS and self-paced graduates, assembled, keypunched and transmitted to HumRRO. Two hundred and forty-nine students having complete records were identified: 105 from the 31E course (46 CTS, 59 self-paced), 54 from the 31J course (36 CTS, 18 self-paced), and 90 from the 35L course (54 CTS and 36 self-paced).

Student records contained two classes of information: The first class, called Background Information, includes EL and GT scores from the ACB, education level and the dates when the student started and graduated the course. The second class of information is labelled Performance Data at the Task Level. This includes the progression index (P.I.), POI hours, actual instructional hours, absence hours, and number of failed attempts on the EPIS test for each Task. The format of the Student Performance Record is shown on Table 3.

Background information was obtained from the computer-stored TREDS history records. Performance data were obtained from manual records (Form 54) kept and updated by instructors and stored by each department for anywhere from 6 to 12 months.

Arrangements were made to use the computing facilities at the Defense Manpower Data Center (DMDC) of the Defense Logistics Agency (DoD). The Defense Manpower Data Center maintains a current version of the Statistical Packages for the Social Sciences (SPSS) data analysis package. Because of the power and convenience of this package, and DMDC's collocation with HumRRO, a decision was made to use

Table 3. Format for CTS and Self-paced Student Performance Records

Card Column(s)	
1-3	Student I.D. Number
4	MOS
5-7	EL Score
8-10	GT Score
11-12	Education Level
13-16	Start Date
17-20	Graduation Date
23-24	Task I.D. Number (First Task in Course)
25	Task Type (CTS or Self-paced)
26-28	POI Time
29-31	Student Learning Time
32-34	Progression Index
35-37	Absence Time
38-39	# No-Goes on EPIS Test
42-58	Repeat of Columns 23-29 (Task 2)
61-77	Repeat of Columns 23-39 (Task 3)
80	Card Number (Five per Student)

Remaining cards repeat task data fields for as many tasks as there are in the course

Also repeated are columns 1-4 and column 80.

their facilities rather than those available at the Data Systems Division at Ft. Gordon.

The punchcard records assembled and keypunched at Ft. Gordon were received at HumRRO on April 14, 1978. The card data were turned over to DMDC for computer storage and analysis by HumRRO personnel using the SPSS package.

CTS Costs

Cost data, maintained by CTS for fiscal years 1973 through 1977 were made available to HumRRO for this study. As presented, the data were organized by capital, developmental and operational costs for hardware, software, courseware and evaluation activities. Personnel costs in dollars for civilian personnel and hours for military personnel were further broken down in terms of activities directly in support of instruction and those indirectly related. Data on personnel costs were further supplemented by information obtained from the CTS time logs described above.

CTS staff training cost data were obtained through sponsor-provided information on in-house and contractor supplied training. Data on these sources of training were obtained where possible for instructors, instructional programmers, applications programmers, data entry specialists, and project management. Copies of available documentation on course content and length were obtained. Time spent in faculty development and other related staff training costs were obtained from the CTS time logs.

Implementation Issues

Data related to implementation issues and problems identified by our study of CTS were obtained from several sources. Data on special qualifications for instructional support staff were obtained from structured interviews described above. Another source of information on these issues was the

side-effect survey administered to management, instructional programmer and instructional personnel employed at the CTS project. The side-effects survey covered unanticipated consequences or outcomes not covered in the more structured series of surveys discussed earlier.

D. RESULTS AND DISCUSSION

In this section of the report, we will describe and discuss our findings. The organization of this section will reflect the six major areas of concern in this study:

- Technical Effectiveness
- CTS Course Development
- CTS Course Administration and Operations
- Training Effectiveness
- CTS Costs
- Implementation Issues

1. Technical Effectiveness

In this section we will describe the CTS hardware/software components and the findings and conclusions of several recent projects that evaluated these CTS components.

Three kinds of formal evaluation activities have been performed on the hardware/software components of CTS. These include the following:

1. Acceptance Tests. Prior to formal government acceptance of the CTS hardware/software system from the developing contractor, a series of tests were performed to determine whether the system met the specifications as described in the development contract. An independent organization, HumRRO, monitored and reported on these tests (Hunter, 1976).

2. Performance Measurements. A study of system resource utilization was performed by the U.S. Army Computer Systems Support and Evaluation Agency (CSSEA), after the system was in operational use at Ft. Gordon (CESSEA, 1977).

3. Alternative Design for Computer-Managed Instruction (COMTRAINS). An independent contractor was employed by the U.S. Army to determine the feasibility of enhancing the CTS hardware/software system to operate in a Computer-Managed Instruction (CMI) mode (Appli-Mation, Inc., 1978).

Following a brief description of the hardware/software, design, the main points from the three evaluations will be listed.

Hardware/Software System Summary

A complete description of the CTS system configuration is contained in the series of manuals and specifications listed in the reference section of this report.

Figure 3 shows schematically the hardware components of CTS.

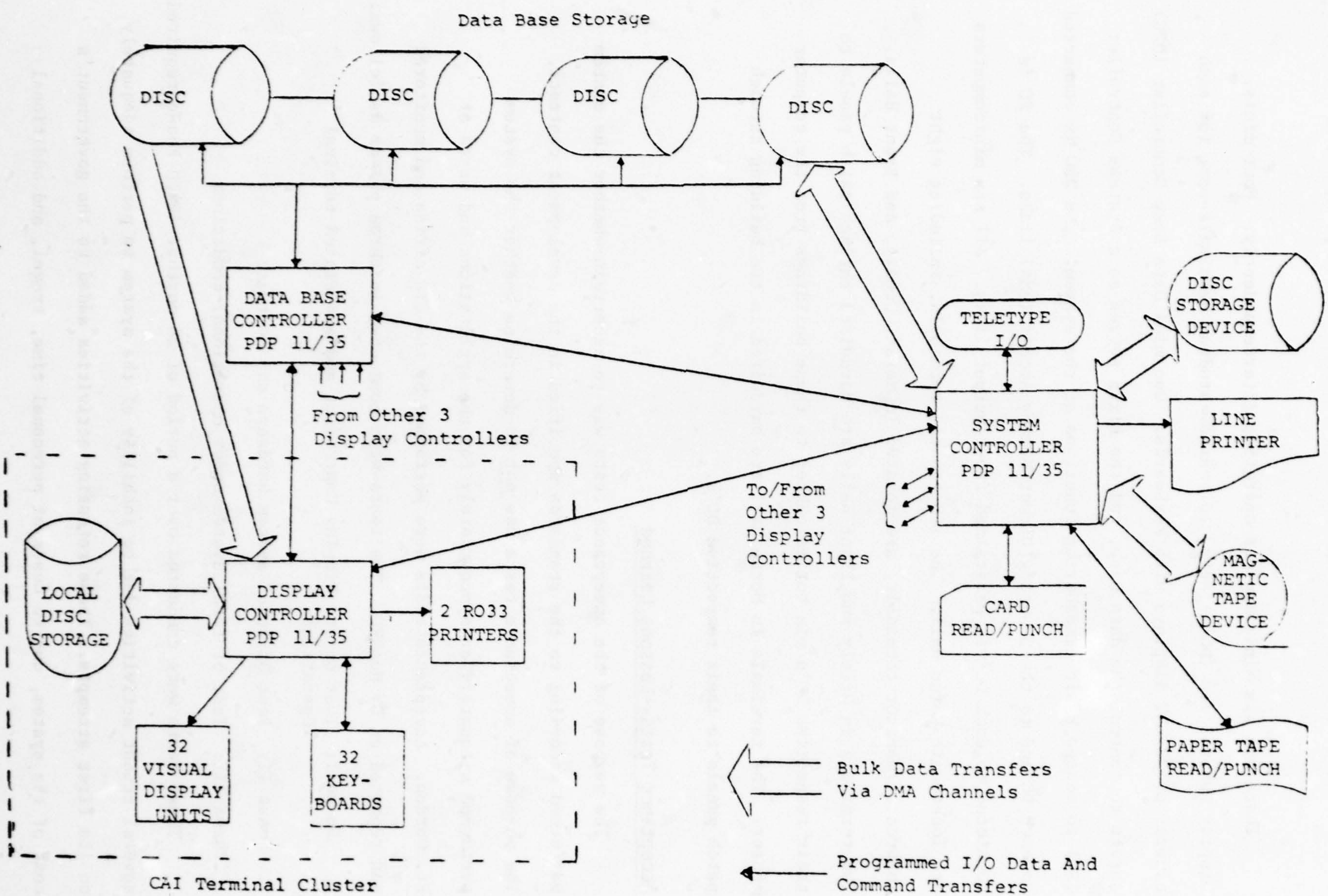


Figure 3. Block Diagram of CTS

There are six minicomputers operating interdependently. Four minis, Display Controllers (DC's) serve to control student terminals--one for each cluster of 32 CRT displays with keyboards. One mini Data Base Controller (DBC) serves to control the data base, and the sixth serves as a Systems Controller (SC) to manage basic timesharing functions of the system. The DBC is connected to each DC and to the SC using Direct Memory Access (DMA) links. The SC is connected to each DC via programmed input/output links. All six minicomputers are located in Moran Hall. The 128 student terminals, including eight instructor/monitor terminals, are located in Moran, Greely, and Brant Halls. The terminals in Greely and Brant Halls are hardwired through patch panels to their respective DC's via buried cables to these buildings from the computer center. The terminals in Moran Hall are hardwired in the building through patch panels to their respective DC's.

Acceptance Tests--Lessons Learned

The purpose of the acceptance tests was to ascertain whether the system performed according to the standards specified in the development contract. The purpose of acceptance tests was <u>not</u> to determine whether the system performed adequately or appropriately for the applications and users at Ft. Gordon. Acceptance tests were performed by the CTS office and monitored and reported on by HumRRO. The tests were conducted in three phases as follows:

Phase I: Test of one Display Controller and associated terminal Operations

Phase II: Test of total system hardware and software

Phase III: Test of total system under operational conditions

These tests were conducted over a period of 28 months. Each Phase required several retest activities due to inability of the system to perform adequately on its first attempts. These retesting activities added to the government's cost of the system, due to costs of personnel time, travel, and additional

contracts involved. The cost of monitoring and reporting acceptance tests by HumRRO was increased by 100%, during the period of the three-phased acceptance test.

One way of avoiding unnecessary costs involved in acceptance testing would have been to include in the original contractor specifications a requirement that the contractor perform complete system tests in-house and report on these tests prior to the government's acceptance tests. This requirement could have specified the hardware, software, environment, and use conditions under which tests should be conducted, as well as system performance criteria.

Another major problem encountered in acceptance testing was the inability to create realistic operational loads on the system. The CTS field office was unable to obtain the large number of students that would be necessary to test actual student load. The Deputy Commandant observed that the students were being used and the system continued to fail. He ordered that no students be used until the contractor could assure the users a reasonable chance of completing the test without failure of the system. Although a load simulator program was provided by the contractor, this simulator did not include enough features to adequately exercise the system and create realistic load conditions. The system would operate reliably under the simulator, but not when live users operated the system. Therefore, realistic response time data could not be gathered.

A third major problem was the lack of a requirement for the contractor to thoroughly test all program changes and document them prior to implementing them on the operational copy of the software. Lack of control over debugging, patching, and retesting of system software during acceptance tests resulted in confusion as to the cause of system failures and considerable system down time during acceptance tests.

Performance Measurements--Lessons Learned

A Performance Measurement and Analysis (PMA) was conducted by the U.S. Army Computer Systems Support and Evaluation Agency (CSSEA, 1977). The purpose of the PMA was to provide CTS with information on the extent to which various components of the 6 minicomputer hardware system were being utilized at Ft. Gordon with the current applications, and workload. The PMA was conducted in March 1977.

Utilization of system components was measured under simulated conditions of an operational load of 400 students using the three USASC&FG course applications but with no on-line instructional programming activity during that time. The analysts concluded that the hardware has a high proportion of unused capacity under these conditions. Unused capacity was calculated to be 94.42% for the high speed input/output channels between the DBC and the DC's. Although central processor activity for the DBC was not measured directly, the low input/output activity to the DBC would indicate low CPU activity as well. (The functions of the DBC require very little CPU activity per data transfer.) CPU idle time for the DBC was estimated at over 90%. Further, all of the course materials for the three courses at Ft. Gordon were held on one of the four disk drives on the DBC. In sum, CSSEA concluded that CTS, as configured and designed under the envisioned workload at Ft. Gordon, was underutilized.

Alternative Design for Computer Managed Instruction

One of the reasons that the present configuration was underutilized is that it was designed for use as a tutorial system in which students were to receive nearly all their instruction by computer. At the USASC&FG and at other Army schools, however, computer support to instruction is currently envisioned in a management support role. The system provides testing and diagnostic functions,

as well as individual student record keeping and graduation prediction activities. Project COMTRAINS (Appli-Mation, 1978) analyzed the CTS configuration and proposed alternative functions for the system as well as modifications to the hardware/ software system.

This study recommended that the CTS be modified to support additional instructional management functions, including resource allocation, student scheduling, improved graduation prediction, user feedback, and remedial reading. Several alternative hardware/software configurations, taking maximum advantage of the existing hardware, were suggested. The existing PDP 11/35 computers can be used for CMI controllers by adding memory and peripheral equipment. The terminals to be provided would be mark-sense readers in combination with a low speed printer and a CRT keyboard-display unit. A more advanced system would consist of a distributed network of minicomputers functioning as CMI controllers. Such computers should be the family of machines of various sizes in order to permit installation of equipment of an appropriate size at each Army school or other training location. (Appli-Mation, 1978).

Summary

The CTS hardware/software configuration of six minicomputers with 128 CRT terminals was not appropriately designed to optimally meet requirements for computer-managed instruction at USASC&FG or at other Army training installations. Current hardware is underutilized, while some key instructional management functions are not being supported. One or more of the DC's could be modified to support CMI functions directly. Once such changes are made, an analysis of the CMI utility of CTS could be performed.

2. CTS Course Development

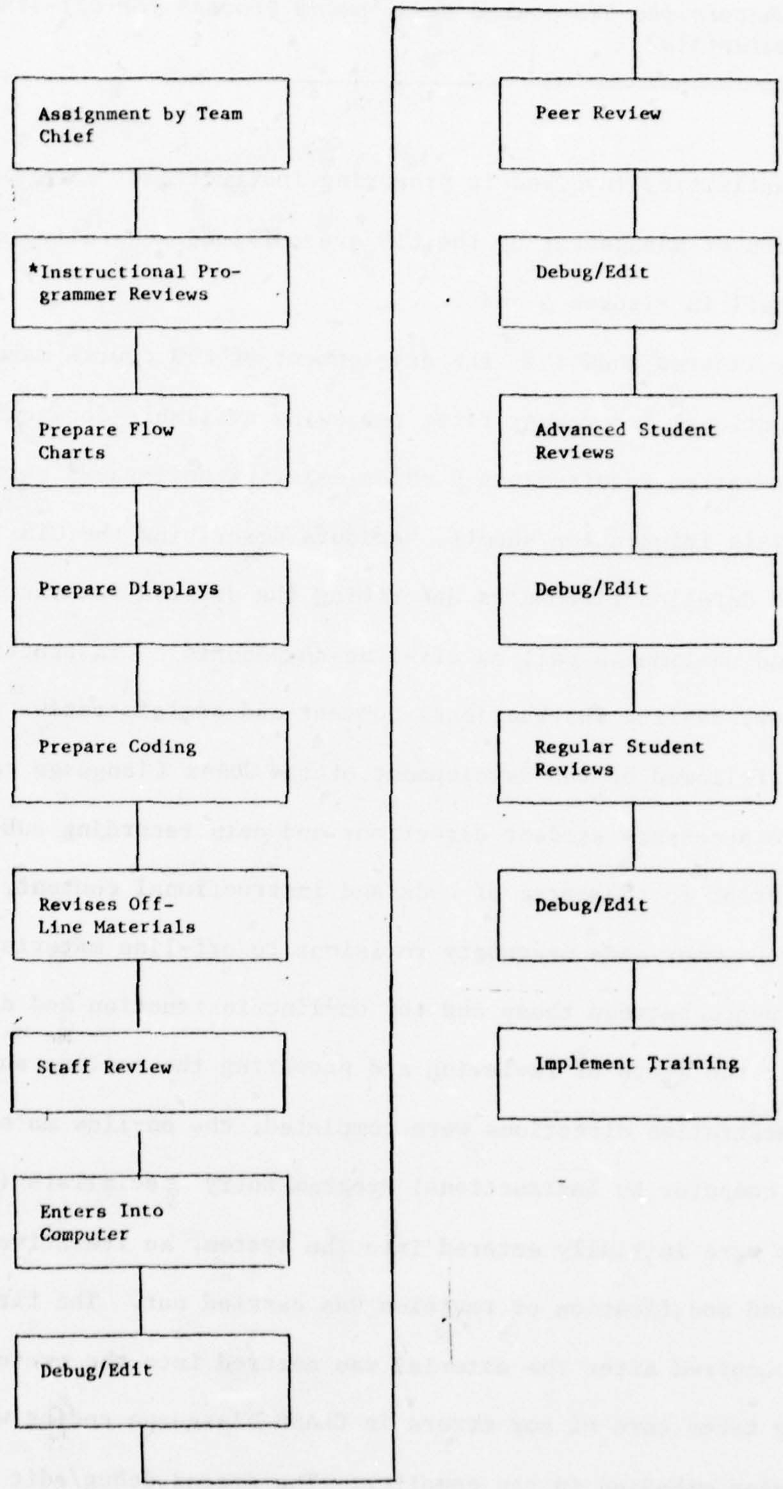
In this section we will describe the CTS course development process and discuss the first seven evaluation questions listed in Section A of the report. The three courses evaluated were: Field Radio Repair (MOS 31E20); Teletypewriter Equipment Repair (MOS 31J20); and Avionics Communication Requirement Repair (MOS 35L20).

1. What is the CTS course development process for off-line and on-line materials?

The activities involved in preparing instructional materials for either presentation or management by the CTS are outlined generally in Figure 4, and in detail in Figures 5 and 6.

These figures show that the development of CTS course materials entailed the instructional programmer first reviewing available documentation on course or subject-matter requirements such as existing self-paced performance guides, task analysis information sheets, handouts describing the CTS instructional model, and detailed flowcharts describing the desired interaction between student and on-line as well as off-line components of instruction. Following this review, on-line instructional content and administrative directions were prepared, followed by the development of the CLAAS I language code which implemented the necessary student directions and data recording sub-routines, or macros. Prior to the entry of code and instructional content, the instructional programmer made necessary revisions to off-line material so that there was congruence between these and the on-line instruction and directions.

After the steps of reviewing and preparing the on-line and off-line content and administrative directions were completed, the on-line materials were entered into the computer by Instructional Program Entry Specialists (IPES). Once the materials were initially entered into the system, an iterative process of debug, review, and modification or revision was carried out. The first debug/edit process occurred after the material was entered into the system and compiled. This step takes care of any errors in CLASS I language coding which violate the syntax rules embodied in the compiler. The second debug/edit review step involved a peer review. That is, the instructional content and directions to the



*Performance Guides
Task Analysis Information Sheets
Hand-Outs

Figure 4. Steps in CTS Instructional Development Process

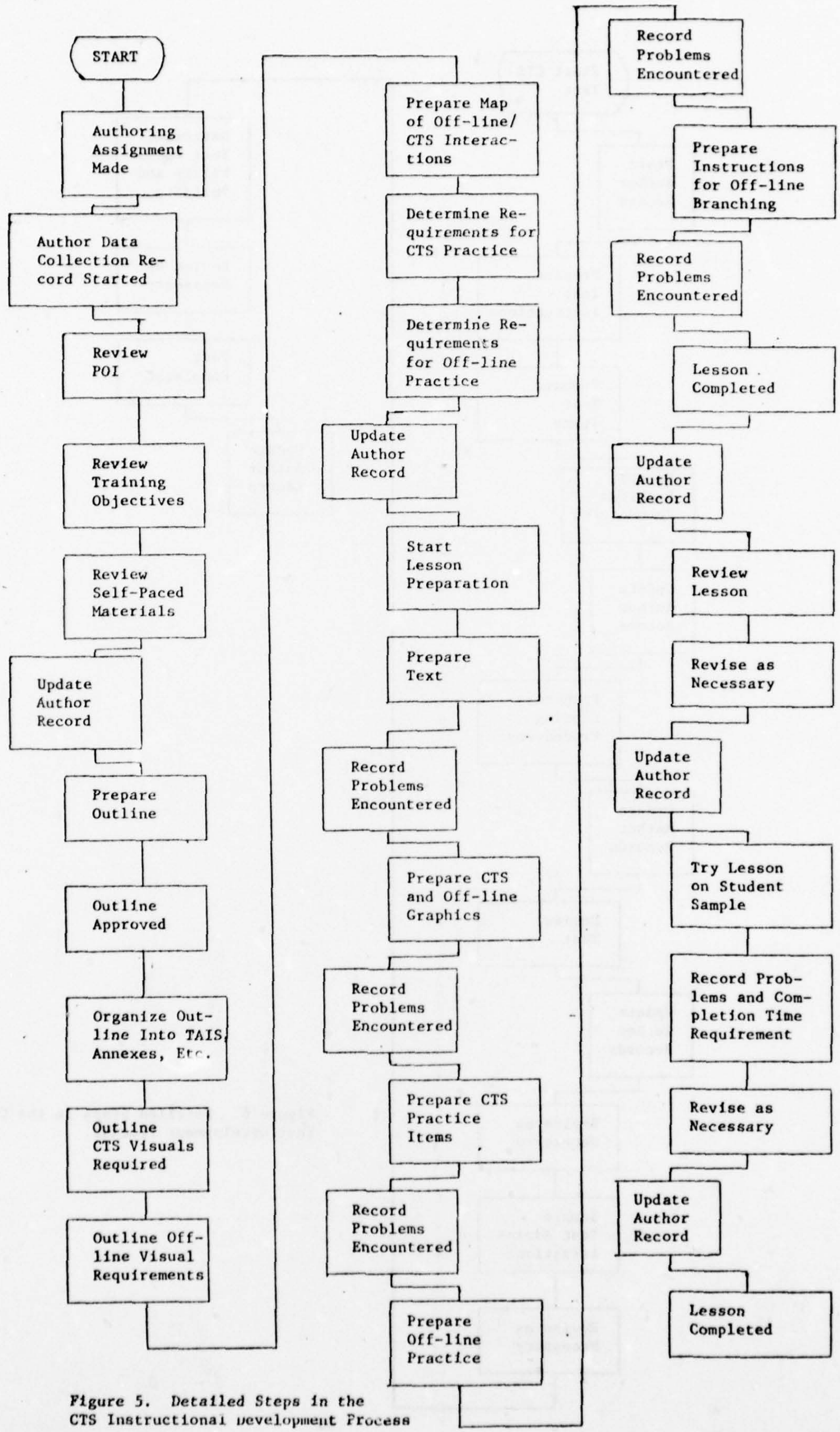


Figure 5. Detailed Steps in the CTS Instructional Development Process

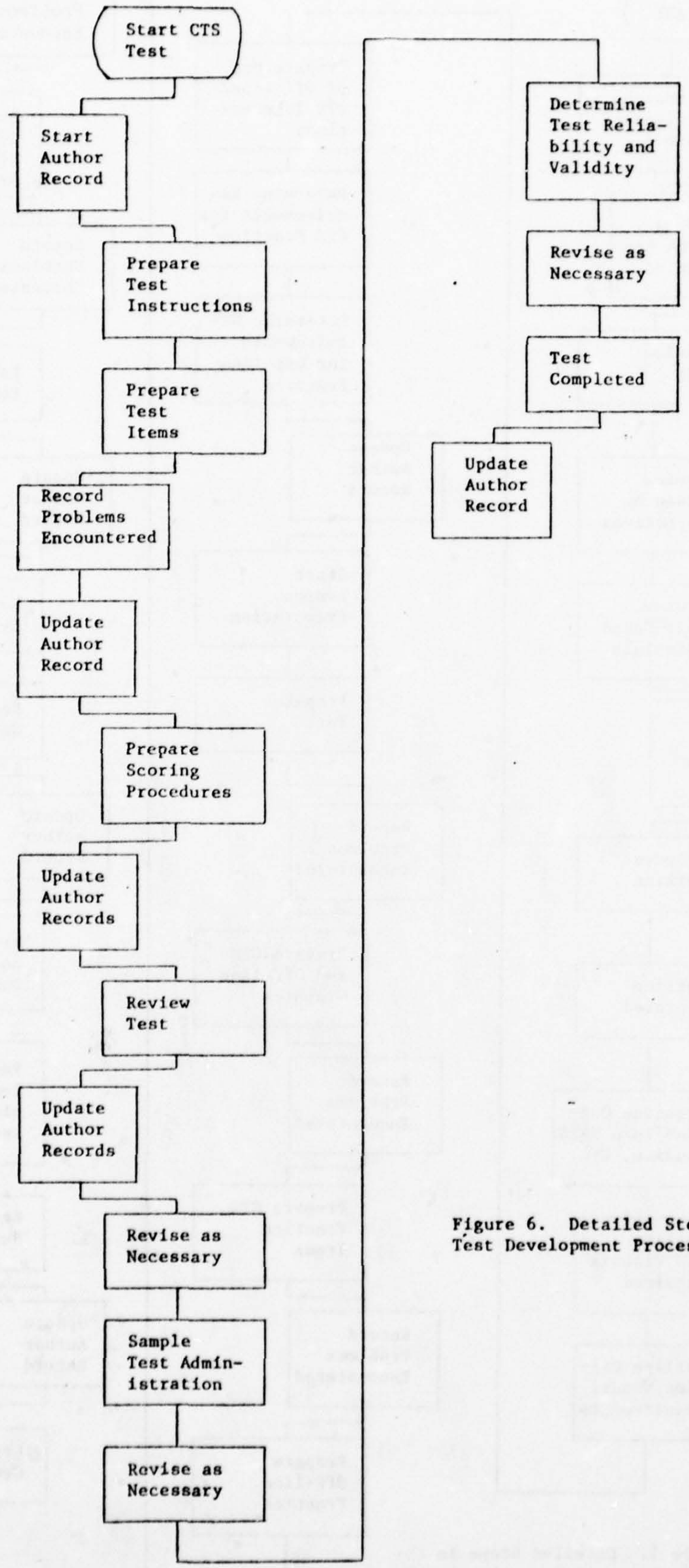


Figure 6. Detailed Steps in the CTS Test Development Process.

student, plus other aspects of the course segment were reviewed and critiqued by the instructional programmer and his colleagues, by instructors, and by his team leader. Appropriate changes were then made.

Following the peer review, the instructional segment was administered to a small group of advanced students who took the instruction and answer test questions in order to identify any components, either instructional or administrative directions, which were inaccurate, incomplete or misleading. Subsequent to their review, appropriate changes were made to on-and off-line text, directions, and language code as necessary. Prior to acceptance and implementation of the instructional unit into the on-going mainstream of the course, the material was administered to regular students in the first full class to encounter the new material in order to identify and correct any deficiencies or weaknesses in the instruction that may not have been apparent to the instructional programmers, peers, or to advanced students.

2. How much time is required to prepare the training and test materials contained in the operational self-paced course Annexes to CTS instructional materials?

Table 4 is a summary of the CTS course development time as derived from the Time Logs. This information is based on actual time charges made by over 30 instructional programmer personnel during the 3+ years for which we had data. Table 5 contains a summary of instructional development time by type of activity as recalled by a sample of this instructional staff during our recent interviews (1978).

It can be seen in Table 4 that almost 65% of the approximately 55,000 hours of course development time was attributed in the time logs to developing on-line materials.[1] The recollections of our interviewees of these percentages were slightly discrepant in the 31J and 35L samples, and quite a bit off in the 31E sample. However, considering the time that had passed, their estimates agreed substantially with recorded times. The total time spent authoring materials was estimated by the 13 interviewees as approximately 39,000 hours. The actual recorded course development times of our sample totaled approximately 31,000 hours. Although our sample was less than half of the CTS course development staff, they accounted for more than 55% of the course materials. In sum, approximately 65% of CTS course development time was used to develop the on-line materials (which accounted for about 11.7% of the POI hours). However, most of the off-line materials had been previously prepared in the self-paced version of the course and thus these percentages should not be used to represent the relative efficiency or inefficiency of CTS course development. Rather, these numbers were used only to obtain estimates of on-line material development time.

[1]The time log data that we used did not include the time that Instructional Program Entry Specialists (IPES) spent in inputting CTS materials. We have since learned that 3 IPES's were phased in during the project and employed full time for this effort. Such times, if known, should be added to CTS course development. However, such data were unavailable.

Table 4. Summary of Course Development Time by Course (from Time Log Data) (Hours)

	FY75	FY76	FY7T/77	Totals
31E				
CTS On-Line	5,146	4,072	2,035	11,252
Other	2,062	1,139	2,635	5,836
Total	7,208	5,211	4,670	17,088
On-Line as % of Total	*71.4*	*78.1*	*43.6*	*65.8*
31J				
CTS On-Line	3,221	5,581	4,624	13,426
Other	1,645	3,473	1,812	6,930
Total	4,866	9,054	6,436	20,356
On-Line as % of Total	*66.2*	*61.6*	*71.8*	*66.0*
35L				
CTS On-Line	3,290	4,493	3,172	10,955
Other	2.699	2,697	1,150	6,546
Total	5,989	7,190	4,322	17,501
On-Line as % of Total	*54.9*	*62.5*	*73.4*	*62.6*
All Courses				
CTS On-Line	11,657	14,146	9,831	35,632
Other	6,406	7,309	5,597	19,313
Total	18,063	21,455	15,428	54,945
On-Line as % of Total	*64.5*	*65.9*	*63.7*	*64.9*

Table 5. Summary of Interview Data by Course and Author of CTS: Instructional Development Time and Activities

Course	Author	# Days Authoring	# Annexes Worked On	% Time Authoring for On-Line	% Time Authoring for Off-Line	% Time Devoted to Authoring Activities for On-Line Materials *a	b	c	d	e	f	g	h	% of Instructional Materials Discarded Due to POI Changes
31 E	(1)	599	All	70	30	-	17	-	17	17	10	7.5	-	10
	(2)	200	1	99	01	5	-	-	10	35	10	5	35	0
	(3)	396	3	75	25	-	37.5	-	4	19	11	4	-	0
	(4)	363	3	90	10	14	54	9	-	4.5	2	7	-	0
	(5)	400	3	95	05	2	19	4	3	27	21	5	14	0
		Σ = 1958												
		$\overline{X}$ = 391.6		$\overline{X}$ = 85.5	14.2	$\overline{X}$ = 4.2	25.5	2.6	8.8	20.5	10.8	5.7	9.8	
31 J	(1)	490	2	40	60	-	16	-	2	16	4	2	-	0
	(2)	538	3	80	20	1	30	30	4	8	6	3	-	10
	(3)	597	3	40	60	4	12	-	4	8	4	8	-	10
	(4)	446	3	75	25	5	15	-	25	25	2	3	-	5
		Σ = 2071												
		$\overline{X}$ = 517.8		$\overline{X}$ = 58.8	41.2	$\overline{X}$ = 2.5	18.25	7.5	8.75	14.25	4	4	0	
35 L	(1)	54	1	100	0	2.5	20	-	-	30	50	2.5	-	0
	(2)	69	1	50	0	17.5	23.5	-	-	-	-	8.5	-	0
	(3)	599	All	62.5	37.5	4.5	20	-	2	21	11.5	4	-	12
	(4)	216	2	60	40	6	36	-	3	6	3	6	-	0
		$\overline{\Sigma}$ = 938												
		$\overline{X}$ = 234.5		$\overline{X}$ = 68.1	19.4	$\overline{X}$ = 7.6	24.9	0	1.25	14.25	16	5	0	

*Key:

- a Planning, Course Outlines, Strategies.
- b Original Authoring (writing, typing, coding).
- c Converting Existing Materials.
- d Modifying Materials due to POI Changes.
- e Reviewing, Debugging, Testing etc., Materials.
- f Revising Materials.
- g Coordination.
- h Other

As can be seen in Table 5, instructional development time was mainly devoted to original authoring, review, debug and revision. Much less time, proportionately was spent in planning, converting existing materials, modifying materials due to POI changes, or coordination. The reason that converting existing materials does not take up more time than reported is probably due to the fact that most of the on-line materials and pre- and posttests were not part of the self-paced courses had to be created from scratch. In addition, since over 100% of the course IP personnel were replaced by August 1976, the retraining period required for replacements to become proficient in all aspects of an IP's activities had to contribute substantially to course development time.

3. What is the average development time (hours) required for one POI hour of instruction in the CAI/CMI mode?

Table 6 shows that over 35,000 hours were attributed to on-line CTS course development during the 3+ years for which we had data. An estimate was obtained from CTS personnel that the on-line portion of the CTS courses accounted for approximately 11.7% of the POI hours. The estimated number of on-line hours for each course is shown in the second column of Table 6.

The average number of course development hours per hour of on-line instruction for all courses was 175. This ratio ranged from 144:1 in the 35L course to 197:1 in the 31J. These ratios would be more than 200:1 if the IPES inputting hours were to be included. Nonetheless, these ratios correspond to other CAI course development data in which materials had to be created anew.

Table 6. CTS On-Line Course Development Time

Course	POI Hours	On-Line Hours	% of POI	On-Line Course Development Hours	Course Development Hours Per On-Line Hour
31E	691	60	8.7	11,252	188
31J*	543	68	12.5	13,426	197
35L	507	76	15.0	10,955	144
Total	1741	204	11.7	35,632	175

*POI hours are shown for only the Tasks converted to CTS.

> 4. *What feedback is available for use in revising instructional materials and tests? How has it been used? What additional feedback is necessary? How would it be used?*

Classroom observation and CTS-generated reports are two principal sources of feedback which enable instructional programmers to perceive a need for revision, to identify what must be revised (test or instruction), and determine the nature and extent of the necessary changes.

Classroom observation carried out during and after the validation process enables the instructional programmer to identify content and procedural difficulties as they are encountered by individual students. CTS reports summarize class progress for various components of instruction in terms of time spent and performance attained.

Questions regarding feedback were asked of thirteen instructional programmers from the three CTS courses. In the 31E and 31J courses, the principal sources of feedback were student comments in the classroom, instructional programmer observation of the classrooms and instructors, and review of their materials by other instructional programmers. With the exception of the 31J course, very few authors reported that they made consistent use of either CTS-generated reports or manually kept records. When asked how they made use of currently available feedback, very few of the authors were able to articulate a systematic procedure for identifying a specific problem area in the instruction or for correcting the material based on the feedback. Only one respondent described a specific process involving his examination of task reports and manual records to identify problem areas in the instruction, and the nature of the problems. The other authors merely responded with phrases such as "just make changes," "make appropriate changes," etc. When asked what additional feedback they would like to

have, only three authors over the entire three courses had anything to say. One author asked for more instructional validation students; another author said that he would like to systematically get the opinions of instructors and instructional programmers.

Four questions in the CTS Course Materials Development Survey dealt with the usefulness of item analysis reports generated quarterly by CTS. These reports provide the instructional programmer with the following: (a) the number of students choosing each incorrect alternative on multiple-choice items, and (b) unanticipated answers for constructed response items. The data are generated for pre- and posttests contained in each TAIS. Table 7 presents the text of each of the four survey items and summarizes the opinions of the instructional programmers who responded.

The first two questions deal with the value of distractor counts in identifying weaknesses in tests and instructional materials. The next two deal with the value of distractor counts and unanticipated reaponses as aids to revision. In all questions but the last, half or more of the respondents were neutral on the value of distractor counts; slightly fewer than half were neutral with regard to unanticipated answers. Five to twenty-five percent of the respondents were positive in their opinions; the remaining respondents were negative. The sole exception to this trend occurred with the question pertaining to unanticipated responses as aids to revision. Here, 48% of the respondents were positive.

These findings indicate that for the most part, instructional programmers were relying on their personal, anecdotal experiences to identify and correct deficiencies in CTS instructional materials and tests. It was found that only 20% or fewer respondents knew about the five CTS reports that provide data useful for revision of materials. Part of the problem stemmed from the fact

that reports were not valid at the time of the evaluation, due to software problems. Thus, they did not use the CTS reports because they did not know of them, or did not know how to use the reports. Findings from the Operational Reports Survey (see pp. 185-208) suggest the former interpretation.

Table 7. Instructional Programmer Personnel Opinions on Districtor Counts and Unanticipated Responses (from CTS Course Materials Development Survey)

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
7.1.4	Distractor counts have identified weaknesses in the instructional material per se.	1	3	14	2	
7.1.4	Pre-test and post-test distractor counts have pinpointed deficiencies inherent in the test questions.	1	4	13	1	
7.1.4	Distractor counts have enabled instructional programmers to make timely revisions to questions and training materials.	1	4	11	1	1
7.1.4	Unanticipated responses are useful when revising instructional material.	2	8	9	2	

5. What difficulties have been encountered in fitting the previously developed self-paced instructional materials into the CTS instructional model?

The responses across the courses to this question can be summarized that, generally, very little difficulty was experienced. There were some sources of problems, but none that were serious. In the 31E course, for example, one author said that CTS was changed to suit the self-paced performance guides because some computer equipment was unreliable, but there were very few changes in the self-paced performance guides due to CTS. In that course, another author said that there was some concern over what should be on-line, what should be off-line, and what branching techniques to use. In the 31J course, author comments concerning some problems encountered in making the conversion were that because POI times differed between self-paced and CTS at the TAIS level, performance guides and lessons had to be redone; that was not difficult, but it was time consuming. Another author in the 31J course said that in his experience, only the course outline and the task lists were used from the old self-paced course, that CTS materials were developed from scratch; the CTS course was developed out of a new training analysis in which new learning sequences were developed for each of the 200 objectives. There was very little of the old self-paced course used except for parts of the performance guides. In the 35L course, the principal comment made by an instructional programmer was that the Directorate of Training Development required the reading level to be simplified. Another author said that the self-paced performance guide designation of instructional units did not correspond to the CTS designation and this had to be changed. Despite the individual problems found by the various authors, the overall feeling of the instructional programmers was that what conversion there was of self-paced to CTS did not present a great problem in its execution.

6. To what extent does the system enable timely modification (e.g., due to POI changes), revision and validation of course materials?

Answers to these questions are suggested in CTS personnel responses to the CTS Revised and Alternate Training Materials Survey (Section I) and from comments concerning POI-based modifications obtained in HummRRO's interviews.

The first part of Table 8 contains the responses of instructional programmer personnel to items on materials validation presented in the Revised and Alternate Training Materials Survey. The data indicate that the majority of respondents agreed that validation procedures under CTS were not only workable but were more efficient than those used for the self-paced or conventional materials. For example, 7 of 13 responses (54%) agreed with the statement that it was easier to validate materials on-line while 4 (31%) did not agree. Eight respondents (62%) agreed that using students in course validation had been helpful in revision and did not impair the review process.

The second part of Table 8 summarizes items dealing with revision of instructional materials. Here, responses suggest that instructional programmer personnel were at best divided on the contribution of CTS to the revision process. According to the second part of the Table, with the exception of tests and units of instructions, about as many respondents perceived more than a little difficulty in making revisions as those who did not.

Perhaps the most critical item concerning revision asks for a response to the statement: "The CTS review process has reduced the time normally required for introducing new or revised materials into the classroom." Of the 12 responses to this item, 8 (67%) disagreed with the statement. This suggests that the prevailing view among instructional programmer personnel was that CTS did not enable timely revisions of course materials.

HumRRO's interviews with instructional programmers addressed the question of how much previously developed instructional materials had to be discarded because of POI changes. This question was included because concern was evidenced over the disruption of the instructional development process by the lack of non-finalized programs of instruction for each course. According to the interviews, very little instructional material had to be discarded because of POI changes. Instructional programmers did indicate that there were cases where new materials had to be developed because new pieces of equipment were added in the POI.

Table 8 . Revised and Alternate Training Materials Survey
Computerized Training System (CTS)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Validation of Training Materials					
It is easier to validate instructional materials on-line than it is to validate conventional or other self-paced printed materials.	3	4	2	3	1
It takes less time to review CTS instructional materials on-line than it does to review self-paced training materials.	1	6	1	4	1
Minor revisions to CTS instructional materials are accomplished during the on-line review process.	3	4	1	2	1
Using students to validate CTS on-line training materials has been helpful in revising instructional units.	3	5	3	1	1
The use of small and large student groups to validate revised CTS instructional units has not impaired the review process.	4	4	4	0	1
Revision of Training Materials					
Little difficulty has been experienced in revising:					
a. Individual displays	2	3	2	4	1
b. Tests	1	5	2	3	1
c. Units of instruction	1	4	3	3	1
d. Flow of instruction	1	4	2	4	1
CTS provides more flexibility in revising instructional materials than does the self-paced system.	3	2	1	5	2
CTS instructional materials can be introduced into the course without the usual printing requirement procedures.	2	3	1	6	1
The CTS review process has reduced the time normally required for introducing new or revised materials into the classroom.	2	0	2	7	1

7. What special problems, if any, were encountered when entering (inputting) training materials on-line?

Information pertinent to this question was taken from the CTS Course Development Survey and from interviews of instructional programmers conducted at Fort Gordon by HumRRO. Table 9, which summarizes responses to items from the survey, is divided into four parts: (A) general items; (B) items dealing with Instructional Programming Entry Specialists (IPES)--clerk/typists trained to input to the system CLASS I commands and text prepared by instructional programmers; (C) items dealing with CLASS I logic coding; and (D) system hardware and software.

Part A of Table 9 summarizes two items dealing with on-line entry in general. It may be seen from the distribution of answers to these items that the majority of respondents were willing to agree that little difficulty was encountered when adding or deleting materials on-line; however, very few would concur with the assertion that a complete CTS unit can be changed overnight

The four items in Part B indicate that instructional programmers generally agreed that the use of IPES caused some problems. Most agreed that IPES personnel had to be supervised, that their typing errors made on-line editing more difficult, and that a shortage of these specialists caused delays in entering materials to the system. In addition, IP's reported in our interviews that their time for lesson development would actually have been reduced had they been permitted to enter their own material on-line. They felt considerable time and effort were expended in pre-formatting materials so that IPES could readily understand what was to be input. In spite of this effort, the IP's spent considerable additional time correcting typing errors.

Two items in Part C dealt with logic coding, that is the development of CALSS I language commands which when executed by the computer implement the

instructional strategy for a given unit. Most respondents agreed with the statement that logic coding has caused few problems when entering materials on-line. On the other hand, according to the second question, more than a few instructional programmers reported logic coding problems due to lack of training or due to the system software associated with compiling and executing the commands. Presumably, problems of this sort were the "relatively few problems" that mostrespondents agreed were present in the item relating logic coding to materials entry on-line.

Part D deals with the role of the CTS hardware and software in problems related to on-line entry of materials. The first question, couched in general terms, reveals that inputting and "saving" lesson materials was encumbered principally by slow system response time and the "loss" by the system of materials already entered, requiring re-entry of the same lessons. A few respondents cited insufficient disk space. This refers to the necessity of waiting a portion of all of a day for disk space to become available so that instructional programmers could work on their materials. The principal effect of system downtime, according to the second item, was to delay course implementation. Nine of the 14 respondents (64%) cited this as a consequence. The final question in Part D inquired into the effect of waiting for system restarts on preparation of materials. Ostensibly, this item should elicit responses similar to those given to the prior question; however, while 8 of 15 answers suggest delay, the remaining 7 said "very little."

Hardware/software problems suggested by the survey items are reinforced by comments made by instructional programmers during interviews. Instructional programmers were nearly unanimous in stating that the inputting, compiling and editing of code was severely hampered by system instability, very slow system response time, unavailability or limited time for inputting due to lack of disk space

and modifications made to system macros which required subsequent modification of already developed code. A representative sample of statements made by instructional programmers in all the courses include: "losing materials during crashes," "system going down," "some units wiped out due to system problems (software) and had to be re-entered," "compiling problems," "inadequate macros." One instructional programmer remarked that the turnaround time for editing and inputting was so slow that the edit-debug-revise process took at least 3 days regardless of the number of errors.

Table 9 . Problems Encountered When Entering Training Materials On-line (from Course Development Survey)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A. General					
Little difficulty was experienced when deleting or adding new or revised CTS instructional materials on-line.	0	11	3	7	1
A complete CTS unit of instruction can be changed over night eliminating any delay in student progress.	1	3	5	7	6
B. IPES					
Instructional programmers must oversee the input of course materials by Instructional Program Entry Specialist (IPES) and/or clerk-typists.	3	10	5	4	0
Delays were experienced in entering instructional materials on-line because of the shortage of clerk-typists and IPES personnel.	3	10	8	2	0
Clerk-typist/IPES personnel experienced little or no difficulty in entering lesson material or logic coding into the system.	1	7	9	6	0
Editing materials on-line has been compounded by IPES/clerk-typist typing errors.	3	10	5	3	0
C. Logic-Coding					
Logic-coding of lesson materials has caused relatively few problems when entering materials into the system.	2	11	5	4	1
Special problems encountered when logic-coding lesson materials:					
7 Insufficient training on logic-coding					
3 Changes to macros created problems					
2 None					

—— Continued ——

Table 9 (continued). Problems Encountered When Entering Training Materials On-Line (from Course Development Survey)

D. Hardware/Software

Problems encountered when inputting and "saving" lesson material during the process of entering courseware on-line.

6	Time slow
5	Lost files caused instructor to re-enter materials
3	Insufficient disk space
1	None

Adverse effect of computer down-time on entering of materials on line.

9	Delayed course implementation
2	Debugging slowed
2	Instructional programmer morale low
1	Updating students slowed

Waiting for system restarts delayed the preparation of instructional materials.

7	Very little
6	Very much
2	Debugging hindered

Management Involvement in the Course Development Process

Supervisory and management personnel were interviewed within the same format applied to instructional programmers. Questions concerning the type and extent of their involvement with the instructional development process revealed that supervisor participation in developing instructional materials was minimal or absent. Of the fourteen persons interviewed, ten reported no participation in any aspect of materials development for presentation by CTS. One course supervisor stated that during development, about 80% of this time was spent in planning and developing course outlines and instructional strategies. Subsequently, these activities occupied about 10% of his time. Two NCOICs and one course division chief reported that between 5 and 10% of their time was spent in reviewing CTS instructional materials.

The apparent remoteness of the managerial personnel interviewed from CTS materials development reflects the organizational structure of which the three CTS courses are components, and the multiple responsibilities carried out by the interviewees. Each course is a component of a division which, in turn, is a component of one of the several departments of the Signal School. Since the majority of the interviewees are in positions at the division level or higher, their responsibilities extend beyond a specific CTS course. Thus, while all respondents indicated managerial activities, including the acquisition, scheduling and coordination of resources (money, equipment, staff and students), only two reported more than 5 to 15% of their time devoted to a CTS course.

3. CTS Course Administration and Operations

In this section we will describe how the three CTS courses operate and discuss evaluation questions 8-11 listed in Section A of the report.

The discussion that follows is organized into five parts: (1) Organizational Structure of CTS Courses; (2) Description of CTS Courses; (3) Instructional Modes Designated for CTS Courses; (4) Student Progression Index; and (5) Generalized CTS Instructional process.

Organizational Structure of CTS Courses

The organizational structure of the three CTS courses is basically the same. The Annex is the broadest organizational breakdown within each course. Each Annex covers training for a major equipment type such as a radio (or class of radios), specific teletypewriter, etc. The next order of breakdown is the Task. In the 31J course there is one to one correspondence between Annexes and Tasks (i.e., each Annex has only one associated Task). On the other hand, the 35L course may have as many as five Tasks associated with an Annex and the 31E course as many as three. In the 35L course, Tasks could cover specific radios within a class of radios, or the Task might cover only one activity (such as align or troubleshoot) for a given radio.

Within each Task the smallest topic of instruction is the TAIS which derives from the smallest unit of job activity identified in Task Analysis Information Sheets. Each TAIS is further broken down in the course into one or more learning elements and a performance element. A learning element presents the student with knowledge required for the TAIS job component. The performance element deals with the application of the knowledge to the behavior (e.g., repair or troubleshoot) that the individual must be able to perform with respect to the particular equipment.

Schematically, the organizational structure of the CTS courses is as follows:

- Annex
  - → Task
    - → TAIS
      - → Learning Element[1]
      - → Performance Element[1]

At each breakdown of the organizational structure students are administered on-line written tests or performance tests. The test associated with each breakdown is as follows:

Task -- A major performance test (EPIS) which covers all the behaviors trained in the Task breakdown of the Annex. In the 31E and 31J courses this performance test is administered in a separate testing room by instructors specifically trained in test administration. In the 35L course the test is administered in the instructional setting.

TAIS -- This Task component has a performance test associated with it that is administered by the classroom instructor and covers the material trained in the one or more associated learning elements and the performance element. Prior to taking the TAIS performance test the student is given the option of practicing further on the equipment he or she is to be tested on. When the student opts to take the test the instructor (not CTS) determines the specific test version that will be administered to the student. The tests are

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[1] In some cases these may be referred to as Learning/Performance or Practice Steps. We have used the term "element" as much as possible.

timed and the time is roughly kept track of by the instructor. Quite frequently, the instructor does not directly interact with the student during test administration but rather will only check the student's work upon completion. Results of the TAIS test are recorded off-line by the instructor and are not recorded on the CTS.

Learning Element -- There may be two on-line tests associated with learning elements--a pretest and a posttest. There is always a posttest covering the material taught in the Learning Element. Except for the 35L course, where there are no pretests employed, pretests will be given for learning elements which do not involve the use of a job aid. That is, if the learning element involves the use of tables or measuring instruments, or some sort of reference in performance of the job, then there will be no pretest. Students have the option of either taking or not taking the pretests. If a student who has opted to take the pretest passes 100% of the items he is permitted to skip the learning element instruction. If he passes less than 100% (the passing score is 80%) he is given what is called narrative remediation providing the correct answers to the missed items and is also allowed to skip the learning element instruction. If the student fails the pretest, and he is failed as soon as he gives incorrect answers to more than 20% of the test items, he is routed into the instruction for that learning element. Pre- and posttests may be the same test but generally are not. The posttest is administered by the computer when the student has completed the materials dictated by the learning element. A passing score allows the student to proceed to the performance element of the TAIS. Failure of the posttest results in directions to study off-line remedial materials.

Description of CTS Courses

A brief description of each of the three CTS courses follows:

31E Course.

Students in the 31E course learn to maintain 4 field radios and two radio teletypewriter sets. The course consists of sixteen Tasks incorporated into 8 Annexes. However, students receive training in only six of the Annexes. Four of the Annexes (totaling 14 Tasks) are taught by CTS. An Annex teaching maintenance of the Chemical Agent Automatic Alarm (M-8) and an Annex providing a maintenance shop training exercise are trained off-line. POI time allotted for the four CTS Annexes of the 31E course is 691 hours. Students enter the 31E course in groups every two weeks.

31J Course.

The 31J course teaches the installation, repair, preventive maintenance and troubleshooting of a number of different kinds of teletypewriter machines. There are 8 Annexes (one Task for each) associated with the CTS course and students enter in a group every two weeks. POI time allotted for the CTS Annexes of the 31J course is 543 hours.

35L Course.

In the 35L Course students learn direct and general support level maintenance of Army Avionics Communication Equipment. The course consists of 15 Tasks incorporated into 5 Annexes. The POI time allotted for the CTS Annexes of the course is 507 hours.

Instructional Modes Designated for CTS Courses

It was intended that the amount, type and degree of difficulty of both initial instruction and remedial instruction would be influenced by the student's past performance. As a consequence various instructional modes were designated

for the three CTS courses. In actuality none of the courses completely fulfilled the requirements for the designated instructional modes. Described below are the designated instructional modes for each course and a discussion of how (if at all) the modes were implemented.

(1) 31E Course.

In the 31E Course there were three designated instructional modes—high, medium and low performance. The level of performance assigned to a student determines the amount and type of instruction that the student will receive. The higher the level of performance the less detailed is the instruction received and also less individual attention is given the student by the classroom instructor. Low performers are generally given a greater amount of instruction through video and audio means than are the high performers. All students enter the course labeled as a "medium" performer. The CTS automatically monitors the students' performance level and adjusts it as appropriate. Performance level is raised (if less than "high") by passing three consecutive tests on the first attempt. These tests may include pretests, posttests, and/or performance tests. The performance level is lowered as a consequence of failing two consecutive tests (not including pretests).

(2) 35L Course

In the 35L Course the same three instructional levels of performance are designated as for the 31E course. However, at the present time all initial instruction is geared to the medium level of performance. Remediation instruction is the only situation where the instructional mode concept of high, medium and low performance level will affect instruction. The process of raising or lowering the performance level is the same for the 35L course as for the 31E course.

(3) 31J Course

In the 31J Course there are 5 designated instructional modes. However, only instructional mode 1 is presently available for implementation. The 5 modes are as follows:

Mode 1 consists of training utilizing a Performance Guide which directs the student to relevant paragraphs in the Technical Manuals. The performance guide also directs the student to specific video tapes.

Mode 2 will consist of mode 1 instruction supplemented with audio instruction.

Mode 3 will include the instruction of modes 1 and 2. In addition, the Performance Guide will amplify the material contained in the Technical Manuals (expanded written narrative of the Technical Manual).

Mode 4 will consist of Mode 3 instruction supplemented with expanded audio and video tape instruction.

Mode 5 is intended to be based primarily on hands-on training.

According to the CTS design, a mode of instruction is selected for a student based on the student's average Progression Index[1] (PI) on completed instruction. If, for example, a student has taken Modes 1 and 2 and Mode 2 has a lower Progression Index (PI), then his subsequent instruction within the annex will be in Mode 2 until and unless the PI in that mode becomes greater than that in Mode 1.

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[1] A discussion of the Progression Index is in the next section.

Student Progression Index

The Student's Progression Index (PI) is a ratio of POI time alloted for a TAIS or Annex and the actual time required for completion of the TAIS or Annex. PI's are automatically computed by CTS and manually computed by the course personnel. CTS can provide two different measures of PI. They are: portal-to-portal PI and academic PI. Portal-to-portal PI is used time divided by POI time. Academic PI is used time minus absent time divided by POI time. In addition to maintaining the student's PI for individual TAIS's and Annexes, a cumulative PI average is maintained both on-line and off-line.

Generalized Instructional Process

Prior Training

Before entering any of the three courses the student will have completed a course in Common Basic Electronics Training (COBET). This course is self-paced and is normally given at Ft. Jackson, South Carolina. The COBET POI time schedule is 4 weeks for the 31E Course, 6 weeks for the 31J Course, and 8 weeks for the 35L Course. A lock-step version of COBET is available at USASC&FG but few CTS students have attended this version.

Enrollment of Student and Creation of Student Record

Before arrival at Ft. Gordon, the student will have been preceded by TRADOC Educational Data System (TREDS) records. These records provide name, social security number, aptitude area scores, and various background information. TREDS records are entered into CTS by the Data Systems Division (DSD) along with course identification, date of entry into course, and various other needed information. All counters are set to zero. A class roster is printed from the CTS student file and is submitted to the Course Chief.

Student Introduction to Course and CTS.

A verbal introduction to the appropriate course is given by the Course Chief. In this introduction the student is told how his course is generally organized, how much time they expect him to take in completing it, when the training periods are, and what are break procedures to be followed.

Following the introductory briefing the student is directed to the classroom where the CTS terminals are located. The classroom instructor gives the student a brief verbal introduction to CTS. The instructor explains the log-on procedure, informs the student of his ID number, asks students to make up a password, and has the student log on to the system for the first time.

The student's first interaction with CTS is a brief lesson dealing with the use of the keyboard and an explanation of the progression of the instruction.

Introduction to Training Materials

The master off-line student control document is the Lesson Study Guide. This guide tells the student the materials and equipment required for each learning element. The guide may also refer the student to appropriate paragraphs in TechnicalManuals (CTS sometimes performs this function also). The guide frequently serves as a workbook in that there may be questions or exercises for the student to complete. It will also contain checkpoints at which the instructor records student completion of a particular study activity. All instruction for the 35L Course takes place in the CTS classroom. That is, each classroom contains its own audiovisual and video tape recording (VTR) equipment, as well as the CTS terminals. In the 31E and 31J Courses, the audiovisual and VTR equipment is located in separate Media rooms. At appropriate times in the instruction, the student is directed to leave the CTS learning room and go to the Media room.

Administration of Basic Electronics Test

The student logs on CTS and is administered a basic electronics test to determine his state of knowledge of basic electronics and areas in which he requires refresher instruction. If the student displays weaknesses on this test he is provided selective remediation. In the 31E and 31J Courses remediation will usually involve study of selected topics at the Media Center. The specific topics for study are defined by CTS for these two courses. In the 35L Course the instructor prescribes the remediation required and will usually administer the remediation instruction himself. In all three courses the student will be re-administered those items on the basic electronics test that he has failed at the initial testing. In those cases where the student again fails the basic electronics test the instructor will work through individual items to determine and correct any problems in understanding.

Recording Entry Time into Annexes, Tasks, and TAIS.

In all CTS courses entry times into Annexes, Tasks and TAIS are recorded both off-line by the classroom instructor and are also recorded on-line on the CTS. The forms used for recording Entry Time (and other information) and the method of recording varies among the three courses. In this section only the 35L Course is described as reported to us regarding what records are maintained and how.

Figure 7 is a copy of a Student Training Record in the 35L Course. Each Task within the course will have its own Student Training Record which is maintained by the classroom instructor. As is shown on the sample Student Training Record, all TAIS's within the Task are also represented. The instructor records the actual time that the student begins instruction in the first TAIS of the course.

STUDENT TRAINING RECORD

NAME: ______________________ STUDENT ID#: __________

TASK: 2 ____ TOTAL COURSE ABS: ________ TASK PI: __________

MTS PDS	LESSON	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TRAINING TIME USED START TIME	START DATE	STOP TIME	STOP DATE	TOTAL HOURS	REMARKS
8	F01-LP1 TAIS	/																				
7	F02-LP1 "																					
22	F03-LP1 "																					
9	F04-LP1 "																					
2	F05-LP1 "																					

The heading above the step columns is LEARNING/PRACTICE STEPS. TRAINING TIME USED is printed over the START and STOP columns.

ANNEX L PROGRAMS USED	(✓) IF USED	REMARKS
1. Course Introduction	TAIS	
2. AN/URM-103/48	TAIS	
3. AN/USM-44		
4. AN/USM-281A/C		
5. ME-30		
6. AN/USM-98		
7. AN/URM-145		
8. TS-585		
9. ME-57		
10. TS-723		
11. AN/USM-207		
12. MK-994		
13. MK-1192		
14. MK-1191		

LEGEND:
/ Current training step
X Finished step
R Remedial
F CTS failure

Figure 7. Sample Student Training Record.

Entry time into the first TAIS of the course is recorded as beginning as soon as the student begins the on-line course introduction. The first TAIS includes a course introduction and the Basic Electronics test, with multi-tracking strategy such as the 35L Course. This TAIS is included in the selected entry Task. Since the Student's Progression Index (PI) is a ratio of POI time allotted for a TAIS and the actual time required for completing the TAIS, a method is needed to adjust the entry Task. The method used for adjusting the first PI is to add time allotted for the introductory TAIS to the POI time allotted for completion of the first TAIS in the entry Task.[1]

Administration of Pretest, When Available

As was stated earlier, there are no pretests for TAIS available in the 35L Course. Pretests are available for some TAIS's in the 31E and 31J Courses. Students have the option of taking these pretests or immediately beginning the instruction. Actual administration of the pretest has already been discussed. However, to summarize, if the student passes the pretest he will advance to the next learning/performance element. If he fails the pretest, he will be given the instruction for that learning element.

Presentation of Instructional Material

Instruction for the particular learning or performance element in the TAIS may be presented by CTS but is usually provided off-line. CTS and/or the Lesson Study Guide will prescribe the specific training the student is to receive. As discussed earlier, initial training in the 31J and 35L Courses is not

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[1] This may differ in the other CTS Courses.

dependent upon the mode assignment of the student or of the performance level to which he is assigned. However, in the 31E Course, the student begins instruction in the first TAIS as a medium performer and will be raised or lowered based on his performance within each TAIS.

Upon completion of instruction for all learning/performance elements in the TAIS the student will report to his instructor. The instructor determines if the student has spent enough time studying. If so, the student is permitted to sign back on to CTS to be administered the posttest for that learning element.

Administration, Scoring and Recording Posttest for Learning/Performance Element

Although strategies used in the three CTS courses varied somewhat, for the sake of brevity we will describe the 35L strategy reported to us. After completing the training for a learning element within the TAIS, the student is administered an on-line posttest. The test consists of 15 items which CTS randomly selects from a test item pool. If the student answers 80% or more of the questions correctly, he will have passed the test. Correct answers are then given to items incorrectly answered. CTS automatically records the student's grade on the posttest and advances the student to the next element. The instructor also records on the Student Training Record that the student has completed that learning/performance element.

If the student fails the posttest, CTS or the instructor will examine the student records to determine if the previously presented test (either posttest or performance test) was also failed. If so, remediation is prescribed.

If the student fails the posttest with a score between 50-69%, CTS will present a message telling the student that he/she has a chance of upgrading the test score to a passing level. Hints will be given on questions missed. These hints refer the student to specific paragraphs in the Technical Manual.

The student then reads the paragraphs and immediately answers the question. There is little chance to make an error. If the student does not obtain a passing level of 70% or greater, he/she is provided remediation and retakes the posttest.

If the student fails the posttest with fewer than 50% of the items answered correctly, CTS will inform the student and the instructor that remedial instruction is needed. The instructor prescribes the remedial instruction. The type and amount of remedial instruction will be determined by the student's performance level (high, medium, or low). The student completes remedial assignment and logs back onto CTS. The instructor verifies on-line that remediation training has been completed and the student is administered a new version of the posttest. Meanwhile, the instructor will post the Student Training Record indicating that remedial instruction was administered.

The student follows the above procedures until the posttest has been passed. The student will then proceed to the next element.

Administration, Scoring and Recording of TAIS Performance Test

After the student has completed all learning elements in the TAIS he or she will be given the option to immediately take an off-line performance test covering the material in the entire TAIS or to receive additional practice before taking the test. If the student opts to take the test the CTS keyboard locks and the message "Select and administer a lesson test version from Supervisor's Guide" is shown on the screen to the instructor. The instructor then selects one of several test versions. Each version will present a particular set of malfunctions in theequipment under study. A typical TAIS Performance Test could consist of four items. The student must get at least two of the four items correct to pass the test. The student is permitted a maximum of ten

minutes for each problem. The student is graded on each question before going on to the next question. If the student is incorrect on a problem, the instructor will consider this a "NO GO" but will critique the problem with the student before going on to the next test problem. If the student fails the test (has a NO GO on 3 or 4 items) the instructor selects and gives appropriate remedial instruction. Following this instruction the test is readministered. This procedure is followed until the student has passed the test.

After the student has passed the test the instructor will post the completion time for the TAIS on the Student Training Record. The instructor will also record on-line on CTS the version used to test the student, and the number of NO GO's the student received.

The student advances to the next TAIS and completes the study and test requirements within that TAIS. When all TAIS's have been completed in the Task, the student will be administered an EPIS test.

Administration, Scoring and Recording of EPIS Test

After completing all TAIS's within a Task the student is administered an EPIS off-line performance test covering all skills taught in the Task. The test is administered by the instructor in the 35L classroom; in the 31E and 31J Courses it is administered in a special testing center. Prior to the test the instructor has the student leave the CTS area. CTS then provides the instructor with directions for test administration and with a randomly selected sample of malfunctions for testing. The instructor may reject this sample and obtain another sample of malfunctions from CTS. The specific sample, or samples, of malfunctions are permanently recorded on CTS. The instructor then recalls the student to the CTS where the student is given instructions for taking the test. The student is then automatically signed off CTS and proceeds to take the test in the same way that he took the TAIS performance test; the instructor

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EVALUATION OF A PROTOTYPE COMPUTERIZED TRAINING SYSTEM (CTS) IN--ETC(U)
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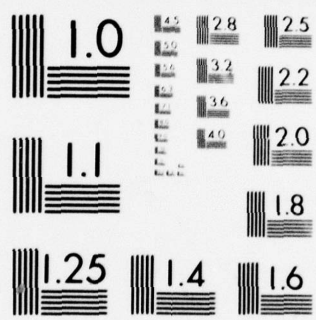

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

responsible for testing judges and records the student's performance. After completing the entire test the student signs back onto CTS and is told to call his instructor to the CTS station. The instructor records the following information: instructor password, test ID number, time allotted for test, whether the test was passed or failed (GO NOGO), and how each individual item was scored. This information is permanently stored in CTS records.

If the student has failed the EIPS test, the instructor determines the type and amount of remediation the student will receive before readministration of the test.

At this time, the instructor updates the Student Training Record and telephones his supervisor to determine which Task the student is to be next assigned. The Student Training Record is forwarded to the supervisor who uses the information contained on it to post a Summary Training Record (see Figure 8).

Course Completion

The student completes the course after successfully completing training in all Annexes of the course. Four and two weeks prior to the course completion date, DA is notified as to when the student will be available for reassignment. On the same day that the student completes training, he or she will receive a certificate of completion and will be returned to his or her unit for out-processing.

SUMMARY TRAINING RECORD

(1) NAME: ____________ (2) SSN: ____________ (3) GRADE: ____________

(4) UNIT: ____________ (5) PREDICTED PR INDEX: ____________ (6) DATE & GROUP ENTERED: ____________

(7) ANNEX	(8) TIME & DATE		(9) HOURS USED		(10) MTS HOURS COMPLETED	(11) HOURS ABSENT	(12) PR RATE		(13) PROJECTION FOR GRADUATION	(14) NUMBER OF RETEST	(15) STAR REPORTS		(16) REMARKS
	START	FINISH	ANNEX	TOTAL			ANNEX	COURSE			FAV.	UNFAV.	
1			POI	manually collected from form 54	cummulative	total non-duty time absences, equip breakdown, holidays – obtained from 54	1-2/3	cum PI average	Not wanted	Not wanted	Not wanted		
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													

(17) ABSENTEE REPORT

SECTION I			SECTION II			SECTION III			SECTION IV		
CODE	HOURS	DATE	CODE	HOURS	DATE	CODE	HOURS	DATE	CODE	HOURS	DATE

(18) CATAGORY X

DATE IN	DATE OUT	REASON

(19) DATE STARTED COURSE: ____________

(20) START GROUP & GRAD. DATE: ____________

(21) GRADUATION REPORTING DATE: ____________

(22) PROSPECTIVE GRAD TIME: ____________

(23) PROSPECTIVE GRAD. GROUP: ____________

(24) CLASS STANDING: ____________

Figure 8. Summary Training Record

8. How useful are the CTS-generated reports for instructors and training managers?

The Operational Reports Survey form was administered to 33 USASC&FG instructional personnel. Fifteen responses were received.

Thirteen of the CTS-generated reports were presented for comment on this form. The results of this Survey form are found in Table 10. Of the 13 reports, 6 were known to only 20% or less of the respondents. These were the

- Student Evaluation Roster
- Course/Task Report (Monthly)
- TAIS Report (Monthly)
- Test Analysis (Monthly)
- Question Analysis--Districtor Count (Monthly)
- Question Analysis--Constructed Response Printout (Monthly)

However, those few instructional personnel who were familiar with these forms regarded them very positively. Thus, it appears that the availability and utility of these reports needs to be communicated to the USASC&FG staff in order that the reports be accepted and used.

Of the other 7 reports, the Student Class Roster was received very favorably with only 13% of the respondents of the opinion that there were numerous errors in the form, or that the format required revision. On the other hand, all of those respondents familiar with this form considered the information presented in this form as essential. A similar reaction was given by those respondents familiar with the TAIS Report (Monthly). Sixty percent of the respondents were familiar with the Weekly Student Activity Report. Of

these, less than 10% had negative reactions to it. The same response breakdown was obtained regarding the Graduation Prediction and Graduation Reports.

The monthly Course Absentee and Company Absentee Reports were familiar to 40% of the respondents. Of these, less than half were not satisfied with the reports as currently formatted and the information they contained.

All of the findings discussed above are based on a respondent population of 15. The responses to our structured interview amplify these findings. Although most of the CTS-generated forms were, by and large, of use to instructional personnel, most stated that they were unaware of their availability. This was probably based on their mistrust of the data and their reliance on the manual records/reports to which they had been accustomed.

Table 10. Responses to Operational Reports Survey (% of Respondents)

Operational Reports Survey Questions	STUDENT CLASS ROSTER	STUDENT EVALUATION ROSTER	WEEKLY STUDENT ACTIVITY REPORT	GRADUATION PREDICTION	GRADUATION REPORT	COURSE/TASK REPORT (monthly)	COURSE ABSENTEE REPORT (monthly)	COMPANY ABSENTEE REPORT (monthly)	TAIS REPORT (monthly)	TEST ANALYSIS (monthly)	QUESTION ANALYSIS (monthly) Distractor Count	QUESTION ANALYSIS (monthly) Constructed Response Printout	STUDENT RECORD PRINTOUT
1. Are you familiar with this report? Yes	60	13	60	47	47	20	40	40	20	20	20	13	33
No	40	87	40	53	53	80	60	60	80	80	80	87	67
2. Is this report available to you?													
a. regularly available	47	13	53	40	40	20	33	40	20	20	20	13	27
b. occasionally available	13	--	7	--	7	--	--	--	--	--	--	--	7
c. seldom or never available	--	--	--	--	--	--	7	--	--	--	--	--	--
3. How frequently do you use this report?													
a. regularly	33	7	20	13	27	7	13	13	20	13	7	13	20
b. occassionally	27	--	27	27	13	13	13	20	--	7	13	--	13
c. seldom or never	--	7	13	7	7	--	13	7	--	--	--	--	--
4. How accurate is this report?													
a. generally accurate	33	7	27	13	13	7	13	20	20	20	20	13	13
b. minor inaccuracies	13	--	20	13	13	13	7	--	--	--	--	--	20
c. numerous errors	13	--	7	20	13	--	13	13	--	--	--	--	--
d. cannot judge accuracy of report	--	7	7		7	--	7	7	--	--	--	--	--
5. What is your opinion about the format of this report?													
a. excellent format	20	--	20	7	13	7	13	13	13	13	7	13	20
b. format is satisfactory	27	7	20	27	20	7	13	13	7	7	13	--	7
c. format requires revision	13	7	12	13	13	7	7	7	--		--	--	7
d. no opinion	--	--	7	--	--	--	7	--	--		--	--	--
6. The information contained in this report is													
a. essential	60	13	40	47	40	20	20	20	20	20	13	13	33
b. non-essential	--	--	20	--	7	--	20	13	--	--	--	--	--
7. The content of this report													
a. should not be changed	33	7	27	20	27	13	20	20	13	20	13	13	20
b. needs minor revisions	27	7	20	27	7	7	13	13	7	--	--	--	13
c. needs major revisions	--	--	8	--	13	--	7	--	--	--	--	--	--
8. How useful do you find this report?													
a. serves intended purpose	40	7	20	27	20	20	13	13	20	20	13	13	33
b. of marginal use	20	7	33	13	20	--	20	20	--	--	--	--	--
c. serves no useful purpose	--	--	7	7	7	--	7	--	--	--	--	--	--

9. Has the System been effective in monitoring students within the respective Tasks and Annexes?

This question was answered by means of eleven items from the Resource Allocation Survey. The items, presented primarily to instructors from the three CTS courses, are organized into three groups shown in Table 11.

The first group, consisting of five items, deals with normal, uninterrupted student flow. The second group, consisting of four items, deals with student flow when insufficient practice and test equipment is available to handle students as they complete one task and are ready to begin the next. The third group (two items) concerns instructor workload. The responses to the three types of items are summarized in Table 11.

The data indicate that under normal student flow, the instructors reported that the system can satisfactorily route the student from task to task and through the entire course, determining and revealing where the student is, with few problems or errors. It may be seen that the majority of responses indicate agreement with statements concerning CTS capacity to perform these functions.

However, responses to items in the second group suggest that instructors perceive the system to be less capable of routing students when demand for equipment and practice stations increases beyond normal. For those items dealing with system tracking of equipment availability, routing of students to alternate tasks, and reporting a shortage of equipment, responses shift from largely favorable to largely neutral or negative. Furthermore, the instructors indicate in the last question of this group that the responsibility for routing students falls on them.

The two items comprising the third group deal with the instructor's role of monitoring student flow before CTS and after its implementation. The first item indicates that the instructors were about equally divided in their belief that accounting for student time prior to CTS was an unnecessary burden. The second item indicates that they remain equally divided on whether CTS usefulness in monitoring student flow offsets associated demands on instructors.

Table 11. Resource Allocation Survey Computerized Training System (CTS)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Group I: Student Flow, Unrestricted Resources					
The computer system has been able to accurately account for the location of each student within the course.	2	7	3	4	1
When the student completes a task, the system routes him to the next task without delay.	1	10	3	2	1
Students are routed through the course according to the predetermined (normal) flow.	0	12	1	1	4
Student routing has been accomplished with a minimum of errors.	2	10	2	3	0
The instructor is alerted via the hard copy terminal when the student has completed all the required tasks.	2	11	1	1	2
Group II: Student Flow, Restricted Resources					
The computer system has maintained an accurate accounting of student position vacancies.	1	2	7	3	3
When student positions in the next sequential task are filled, the student is routed to an alternate task, for which he has the necessary prerequisites.	2	3	7	3	1
When the student completes a task and all student positions in the succeeding tasks are filled, the instructor is alerted via the hard copy terminal.	2	2	9	3	1
Routing students to the correct student positions has required close monitoring by the instructor/supervisor.	5	6	3	2	0
Group III: Instructor Support					
Prior to CTS, did accounting for student time in the course place an unnecessary burden on the classroom instructor?	Yes 6	No 8			
Does the usefulness derived from using the computer for accounting for students' time in the CTS tasks outweigh the workload inherent in its collection?	Yes 5	No 5			

10. Were sufficient resources available to handle the student load?

The Instructional Process Survey, designed to answer this question, could not be used because only two respondents returned completed instruments. However, during extended site visits to all three courses, it was evident to HumRRO personnel that little or no queueing occurred at the computer terminals during class sessions. Students were able to interact with the CTS whenever required by the student manual or by the instructor. Further, interviews with instructional programmer personnel suggested that available CTS resources had no adverse affect on the courses' ability to handle student throughput.

11. Is there an adequate back-up capability to provide instruction during computer down-time?

Information concerning back-up capability could not be obtained from the Instructional Process Survey as originally planned because of the almost total lack of response to that instrument. Classroom observation and structured interviews of CTS personnel by HumRRO scientists indicate, however, that available back-up materials were sufficient to ensure the continuation of instruction during computer down-time. Hardcopy versions of on-line tests enabled instructors to administer, score, and record pre- and posttests; the instructors could give assignments based on their familiarity with the course content and the instructional strategy. It is possible that had on-line instruction comprised a higher percentage of each of the courses, off-line back-up may have been overtaxed. Instructors reported, however, that since on-line instruction comprised only 11-12% of the courses, they could handle students at those times when the computer was down.

Supervisory/Management Comments Related to Course Administration

Many supervisory respondents used HumRRO's structured interview as an opportunity to discuss problems they perceived or experienced during their involvement with CTS. A concern expressed consistently across the large majroity of supervisors associated with all three courses was the diversion of instructor personnel to CTS-related duties with no provision for additional help in other ongoing training responsibilities. A typical comment: "Instructional programming came out of our hide, which meant that there was an increased burden on other instructors." Another respondent remarked on a "need for authorized staffing for CTS; (we are) using instructors, which means that less manpower is available for other tasks." These problems occurred even though the CTS field office supported and augmented the USASC&FG course development effort initially with 9 people.

In a related area, several supervisors remarked on the problems associated with personnel turnover; their feeling was that trained, experienced personnel did not stay on the job long enough to provide continuity to the instructional development process. One Division Chief expressed the opinion that "experienced, key personnel should have stayed with the course, but military personnel stay for a maximum of 18 months and civilians look for promotion."

Another frequently voiced concern was over the apparent "inaccuracy" of the CTS-maintained records on training time, absence time and progression indexes. Supervisors in two of the CTS courses cited discrepancies between the length of an instructional period as employed in the course and that employed by the computer system to compute training time. Specifications for length of the instructional period were not kept current. Thus, the progression indexes computed manually by instructors differed from those generated by the CTS system.

Others complained of the difficulty encountered in maintaining accurate absence time in the CTS system. One respondent remarked that it was difficult to enter absence data into the system. If a student had progressed to a new Task or TAIS before a valid absence time could be entered, the system would not accept the data. To the extent that absence entries were incomplete, the system-recorded training times and computed progression indexes would be inaccurate.

Other comments by supervisors included: "They shouldn't experiment using an ongoing training course"; "there was turmoil when the CTS conversion was added to the requirement for self-pacing"; "management wouldn't become involved with CTS problems"; "cheap hardware and not enough storage"; and "there were problems with the software."

HumRRO's interviewers were struck by the absence of positive comments on the part of management personnel concerning CTS. Unlike the instructional programmers who appeared involved and to some extent dedicated to making CTS work, the supervisors gave the strong impression that CTS was viewed as an impediment to the school's principal goal of turning out course graduates in the time expected and numbers required.

4. Training Effectiveness

In this section we will describe and discuss those evaluation questions which deal with the training effectiveness of CTS (Questions 15-18).

> 15. *What is the average student progression index by Task and Annex for each CTS course? What is the standard deviation? How many graduates were there in each course?*

31E Course

CTS personnel estimated that approximately 11.7% of all the CTS course material was on-line. Of this material, most was made up of pre- and post-tests. For the 31E course, 60 hours or approximately 8.7% of the 691 POI hours were on-line. The actual training hours on the average in the CTS version of the 31E course (764) was 10.6% more than that allocated by the POI. The Self-Paced 31E Course training time was 84% of that allocated by the POI (653 hours).

It was decided that those tasks with different POI hours in the CTS and Self-Paced versions of the courses would be removed from any comparative analyses (Tasks 1, 7 and 10 in the 31E Course). Although one could compare PI's indepedently of POI hours, it was felt that POI hour changes might have reflected substantive content alterations. The effects that these modifications might have had on training time are not known and, thus, we felt should be deleted from any comparative analyses. We have presented all the 31E data in Table 12, however, to provide the reader with a comprehensive picture of our study's findings.

Comparisons were made between the CTS and Self-Paced actual training times expended by Task (for those Tasks with identical POI hours). The results show that the CTS version was significantly more efficient only in Task 9. Self-paced training times were significantly lower than CTS in Tasks 2, 3, 4, 8, 11, 13, and 14. No significant differences were found for the remaining Tasks (5, 6, and 12). The overall comparison for these Tasks (without 1, 7 and 10) showed

Table 12.. Training Time Data--CTS and Self-Paced 31E Course

Tasks		POI Hours	Actual Hours to Complete		Academic Progression Index		N
			$\bar{x}$	S.D.	$\bar{x}$	S.D.	
1	CTS	101	116.6	43.2	1.16	.43	46
	Self-Paced	87	85.6	18.6	.98	.21	59
2	CTS	54	33.1	20.4	.61	.38	46
	Self-Paced	54	25.9*	8.6	.48*	.16	59
3	CTS	36	39.7	12.6	1.10	.35	46
	Self-Paced	36	24.8*	8.2	.69*	.23	59
4	CTS	59	134.8	42.1	2.28	.71	46
	Self-Paced	59	113.2*	24.5	1.92*	.42	59
5	CTS	69	34.7	12.5	.50	.18	46
	Self-Paced	69	34.7	11.7	.50	.17	59
6	CTS	68	66.9	88.0	.98	.17	46
	Self-Paced	68	70.7	43.2	1.04	.64	59
7	CTS	70	120.8	54.7	1.73	.78	46
	Self-Paced	56	64.7	50.7	1.16	.91	59
8	CTS	50	24.4	8.9	.49	.18	46
	Self-Paced	50	18.9*	12.9	.38*	.26	59
9	CTS	33	10.0	5.8	.30	.18	46
	Self-Paced	33	30.0*	24.6	.91*	.74	59
10	CTS	35	92.9	58.6	2.52	1.40	46
	Self-Paced	25	27.0	20.9	1.08	.84	59
11	CTS	23	9.9	4.4	.43	.19	46
	Self-Paced	23	8.2*	3.5	.36*	.15	59
12	CTS	24	13.2	6.7	.55	.28	46
	Self-Paced	24	13.0	7.6	.54	.32	59
13	CTS	24	47.3	18.5	1.97	.77	46
	Self-Paced	24	19.9*	18.9	.83*	.79	59
14	CTS	45	19.9	6.7	.44	.15	46
	Self-Paced	45	13.0*	5.9	.29*	.13	59
Course: 31E							
	CTS	691	764.2	--	1.11	--	46
	Self-Paced	653	549.4	--	.84	--	59

*Significantly different at $\alpha = .05$, 2-tailed

that the CTS version took a significantly longer time for the students to complete than the Self-Paced version. The ability level of the student population, however, was not significantly different (as measured by GT scores--CTS GT $\bar{x}$ = 114; Self-Paced $\bar{x}$ = 112). Thus, the course context/format appears to be the sole contributing factor for these findings. The differences between CTS and Self-Paced training time appear to be mostly due to the pre- and posttests that were part of the CTS courses. A serious question is raised regarding the efficacy of a pre-/posttest instructional design if the course is performance-oriented (with criterion performance tests), and the students' entering state of knowledge is quite low. In the latter case, all students receive the same instruction, no matter what the pretest outcome. This situation surely contributed to the relatively slow progress of the CTS group.

31J Course

In Table 13 we show the time data obtained from the 31J Course. However, as indicated elsewhere, the students going through the CTS course were in the process of validating training materials (none of the students completed a fully validated, operational 31J CTS course). In fact, to this report's date, only 8 Tasks of the 31J course were put in the CTS version with no intention on the part of course personnel to complete this conversion. Therefore, it was felt to be inappropriate for any comparative data analyses to be performed on this course.

35L Course

In Table 14, we show the time data obtained from the 35L Course. As can be seen, not one Task had the same allocation of POI hours in the CTS and Self-Paced versions. Therefore, no direct comparisons of Task training times in this course were made. Overall, the PI's for CTS and Self-Paced versions do not appear to be different.

Table 13. Training Time Data--CTS and Self-Paced 31J Course

Tasks		POI Hours	Actual Hours to Complete $\bar{x}$	Actual Hours to Complete S.D.	Academic Progression Index $\bar{x}$	Academic Progression Index S.D.	N
1	CTS	94	119.6	34.4	1.27	.37	37
	Self-Paced	94	86.0	13.4	.92	.14	17
3	CTS	50	89.0	32.8	1.78	.66	36
	Self-Paced	56	66.7	21.6	1.20	.39	18
5	CTS	38	32.9	11.2	.82	.23	37
		39					
		68					
	Self-Paced	39	65.7	18.7	1.02	.24	17
		68					
7	CTS	60	66.3	17.5	1.11	.29	33
	Self-Paced	60	108.3	44.2	1.33	.47	21
		85					
9	CTS	85	64.6	Ø	.76	Ø	1
	Self-Paced	137	149.5	31.7	1.09	.23	17
11	CTS	89	56.1	Ø	.63	Ø	1
	Self-Paced	89	63.Ø	15.8	.70	.18	35
		90					
13	CTS	83	N/A	N/A	N/A	N/A	N/A
	Self Paced	80	74.9	74.9	.93	.28	36
		83					
15	CTS	44	34.4	4.8	.78	.09	36
	Self-Paced	44	31.5	8.5	.72	.23	18
Course: 31J							
	CTS	543	462.9	--	1.01[1]	--	
	Self-Paced	599-657	645.6	--	1.08-.98	--	

[1] Based on POI hours=460 (543 minus 83; adjusted for no CTS data on Task 13.)

Table 14.. Training Time Data--CTS and Self-Paced 35L Course

Tasks		POI Hours	Actual Hours to Complete $\bar{x}$	S.D.	Academic Progression Index $\bar{x}$	S.D.	N
1	CTS	122	108.1	27.9	.90	.23	49
	Self-Paced	74	66.6	22.9	.90	.31	36
2	CTS	{ 112 114 }	96.6	24.6	.88	.24	34
	Self-Paced	77	89.7	25.2	1.17	.33	36
3	CTS	80	93.2	28.6	1.17	.36	54
	Self-Paced	98	76.0	18.1	.78	.19	36
4	CTS	73	68.9	15.4	.94	.21	54
	Self-Paced	76	75.9	20.1	1.00	.26	36
5	CTS	80	84.9	26.3	1.06	.33	54
	Self-Paced	72	71.9	23.2	1.00	.32	36
Course: 35L							
	CTS	467-469[1]	451.6	--	.97-.96	--	
	Self-Paced	397	380.1	--	.96	--	

[1] Course POI = 507 hours; performance data on 38 POI hours (Test Equipment) not available.

16. What was the number and percentage of students who failed to graduate from each CTS course?

The data we received[1] indicate that there were 305 graduates of the 31E CTS course in FY 1977. During that year, there were 22 academic losses. In the period October 1977-March 1978, an additional 97 personnel graduated this course and 22 attrited for academic reasons. In the 35L course, 70 CTS students graduated in the period July 1977-May 1978. Eleven (11) students failed to graduate in that period. Only 8 students were listed as having graduated the CTS 31J course, although only a portion of that course has been put on CTS. The 31J training time data that we used came from students during validation of the training materials. This reinforces the contention that only in the 31E and 35L courses was the training system stable enough for some meaningful data analyses to be performed; and only in the 31E course were POI hours stable enough. Therefore, in the 31J course, it appears that all student performance data are highly tenuous and should not be considered as providing a basis from which to draw any conclusions.

[1]Personal communication.

17. What are student attitudes towards CTS courses?

Student attitude data were gathered both before and after training in the 31E course. The attitude data revealed no consistent differences between initial and final administration. Therefore, we will concentrate our discussion only on the final set of data. Anonymous responses were obtained from 34 students on the post-course attitude survey. The student attitude questionnaire containing summary data is included as Attachment #9. Sixty-two (62) of the 79 items required the respondent to rate a statement on a five-point scale which ranged from "strongly agree" to "strongly disagree." The remaining items solicited background information, student perspectives about on-line instructional time, and open-ended questions related to course specifics. *Nine students (out of the 34) had some prior CBI experience.* The questionnaire is divided into four sections. The four sections are:

Section I - items related to instructional content and media, and the learning environment, including both physical and support characteristics.

Section II - items related to the computer management aspect of the training experience including both environmental and pedagogical items.

Section III - items related to scheduling of on-line time.

Section IV - student likes and dislikes about the system.

SECTION I RESULTS

Instructional Materials. For those items which were answered definitely (not "neutral"), the students felt that the instruction was too hard (possibly because the reading level is too high (item 8) and the step size was too large. Students reported using the pre-and post-test as a self-management tool to obtain more instruction. However, they did find the material interesting and the course objectives clearly stated. About one-third of the students would prefer more instruction delivered via CTS, while the majority would not.

Support. The students found the instructors to be knowledgeable, but not always available when required. The responses to item 18 indicate that the students felt isolated and/or ignored while working with CTS.

Learning Environment. Generally the students liked to use the computer terminals as an instructional device. They were dissatisfied, however, with the plethora of media which they had to use.

SECTION II RESULTS

Instruction. The directions to the student were perceived as easy to follow. The instructors referred the students to the computer for directions, rather than providing them themselves.

Hardware. The students felt that the combination of computer down-time and lack of availability of computer terminals impeded their utilization of the systems.

SECTION III RESULTS

Scheduling. Most students spent an average of 20 to 30 minutes at the computer terminal in a single session that coincides with the time in wh ch they get uncomfortable before taking a break. However, when asked how lo g

others should work at a terminal without a break, they recommended 30 to 50 minutes, and if breaks were permitted--one hour. The maximum time recommended for a student to spend at a terminal without a break, is 45 minutes. Again, this is longer than the respondents themselves spent at the terminal. Most students were willing to spend up to three hours per day interacting with the computer.

SECTION IV RESULTS

What the students liked best--the rank order of the most preferred aspects of computerized instruction is shown below:

- I can go at my own speed.
- It presents materials in a clear and interesting way.
- I am always being asked questions.
- I like the freedom offered by CTS.
- I am not bothered by an instructor except when I need him.

What the students liked least--the rank order of the least desirable aspects of computerized instruction is shown below:

- I cannot ask questions.
- It leaves out too much information that an instructor would provide.
- I have to learn to operate too much instructional equipment.
- It is too impersonal.
- It is too much work.

18. *What is the relationship between student scores on CTS administered task tests and Progression Index values? What percentage of students passed CTS tests on the first try?*

Tables 15, 16, and 17 show, for each course, the percentage of students passing Task (EPIS) tests in one, two, and three or more attempts. Pass rates are presented in all cases for CTS administered Tasks; where available, comparable data are presented for Self-Paced Tasks.

Table 15 presents findings for the CTS students in the 31E course; no information was available on Self-Paced students. It can be seen from the table that at least 80% of the CTS students passed the majority of the Task tests on the first try. In the last five Tasks of the 31E course, the percentage of first-try success ranges from 59% (Task 10) to 74% (Task 14) with most of these values clustering around seventy percent.

Table 16 shows that for the 31J course a generally higher percentage of CTS students passed the Task tests on the first try. In the case of Task 15, the first attempt success rate was 100% for both CTS and Self-Paced students. However, in the remaining Tasks, the first attempt passing percentage of CTS students ranged from 81% (Task 5) to 97% (Task 3), while among Self-Paced students the first attempt passing percentages, with the exception of Task 1, were all substantially less than 80%.

For the 35L course, Table 17 shows that the first attempt pass rate was generally high for both CTS and Self-Paced students on all comparable Tasks. In only one Task (Task 4) was there a notable difference; in this case the value is 100% for the CTS students and 72% for those in the Self-Paced version.

The question concerning the relationship between performance on Task tests and Task Progression Indices (PI's) for CTS students was raised because the latter measure has been prominent as a benchmark of success to both

Table 15. Percentage of CTS and Self-Paced Students Passing 31E EIPS Tests on the First, Second, and Third (or higher) Attempt

		CTS		Self-Paced[1]
Task	Attempt	Percent	N	
1	1	87	(40)	
	2	11	(5)	
	3+	2	(1)	
2	1	89	(41)	
	2	9	(4)	
	3+	2	(1)	
3	1	87	(40)	
	2	13	(6)	
	3+	Ø	(Ø)	
4	1	87	(40)	
	2	11	(5)	
	3+	2	(1)	
5	1	76	(35)	
	2	22	(10)	
	3+	2	(1)	
6	1	87	(40)	
7	1	86	(39)	
	2	6	(3)	
	3+	9	(4)	
8	1	83	(38)	
	2	13	(6)	
9	1	80	(37)	
	2	13	(6)	
	3+	2	(1)	
10	1	59	(27)	
	2	15	(7)	
	3+	26	(12)	
11	1	72	(33)	
	2	22	(10)	
	3+	2	(1)	

[1]No Self-Paced 31E data regarding EIPS tests were available.

— continued —

Table 15 (continued). Percentage of CTS and Self-Paced Students Passing 31E EPIS Tests on the First, Second and Third (or higher) Attempt.

		CTS		Self-Paced[1]
Task	*Attempt*	*Percent*	*N*	
12	1	67	(31)	
	2	13	(6)	
	3+	15	(7)	
13	1	67	(31)	
	2	13	(6)	
	3+	15	(7)	
14	1	[illegible]4	(34)	
	2	23	(10)	

[1]No Self-Paced 31E data regarding EPIS tests were available.

Table 16. Percentage of CTS and Self-Paced Students in the 31J Course Passing EPIS Tests on the First, Second and Third (or higher) Attempt

	CTS			Self-Paced	
Task	Attempt	Percent	N	Percent	N
1	1	88	(28)	87	(14)
	2	9	(3)	13	(2)
	3+	3	(1)	Ø	(Ø)
3	1	97	(31)	63	(10)
	2	3	(1)	31	(5)
	3+	Ø	(Ø)	6	(1)
5	1	84	(27)	75	(12)
	2	16	(5)	25	(4)
	3+	Ø	(Ø)	Ø	(Ø)
7	1	81	(26)	56	(9)
	2	19	(6)	31	(5)
	3+	Ø	(Ø)	13	(2)
15	1	100	(32)	100	(16)
	2	Ø	(Ø)	Ø	(Ø)
	3+	Ø	(Ø)	Ø	(Ø)

Table 17. Percentage of CTS and Self-Paced Students in the 35L Course Passing EPIS Tests on the First, Second and Third (or higher) Attempt

	CTS			Self-Paced	
Task	Attempt	Percent	N	Percent	N
1	1	94	(51)	100	(36)
	2	6	(3)	Ø	(Ø)
	3+	Ø	(Ø)	Ø	(Ø)
2	1	98	(53)	89	(32)
	2	2	(1)	11	(4)
	3+	Ø	(Ø)	Ø	(Ø)
3	1	96	(52)	100	(36)
	2	4	(2)	Ø	(Ø)
	3+	Ø	(Ø)	Ø	(Ø)
4	1	100	(54)	72	(26)
	2	Ø	(Ø)	28	(10)
	3+	Ø	(Ø)	Ø	(Ø)
5	1	96	(52)	100	(36)
	2	4	(2)	Ø	(0)
	3+	Ø	(Ø)	Ø	(Ø)

students and instruction. While CTS students pass most Task tests on the first try, thereby showing a high level of subject matter mastery, failure does invoke a computer-prescribed remedial sequence which must be completed before the student is permitted another try at the test.

The fact that Task Progression Indices under CTS tend to be higher than anticipated may be partially explained by the individualized remediation capability contained within the CTS instructional model. To test this possibility, Rank-Order correlations were computed in each course between Task Progression Indices and number of unsuccessful attempts at Task tests. Should this relation hold true, we would expect positive correlations between these two variables.

Tables 18, 19, and 20 present the findings for each of the courses. For the 31E course (Table 18) it may be seen that in all Tasks for which data were available, the correlation between PI and number of "No Go's" is positive with the exception of Task nine. For eight of the Tasks as well as for all Tasks taken together, the correlations are significant at or beyond the .05 confidence level. Even though the size of the correlations is not large, their direction lends support to the notion that the CTS prescribed remediation requirement as a result of EPIS test failures served to increase the PI's.

The findings for the 31J course and the 35L course also tend to support the suggested influence of CTS remediation on Task Progression Indices. Table 19 shows that of the four 31J Tasks for which data were available, all correlations for two Tasks as well as for all Tasks considered together are significant at or beyond the .05 level. According to Table 20, the number of "No Go's" in the 35L correlates positively with Progression Index for all Tasks and for each Task taken separately. The correlations for two tasks and for all Tasks taken together are significant at the .05 level.

Table 18. Rank Order Correlation between Task PI and Number of Unsuccessful Attempts at Task EPIS Test; for CTS Tasks of the 31E Course

Task	r	n
1	.17	(46)
2	.27*	(46)
3	.19	(46)
4	.21*	(46)
5	.38*	(46)
6	●	
7	.26*	(46)
8	.17	(44)
9	-.15	(44)
10	.23*	(45)
11	.16	(44)
12	.39*	(44)
13	.35*	(44)
14	.21*	(44)
All Tasks	.31*	(40)

* = $\alpha \leq .05$ one-tailed (Kendall's Tau)
● = not computable

Table 19. Rank Order Correlation between Task PI and Number of Unsuccessful Attempts at Task EPIS Test; for CTS Tasks of the 31J Course

Task	r	n
1	.36*	(32)
3	-.15	(32)
5	.43*	(32)
7	.06	(32)
15	•	
All Tasks	.31*	(32)

* = $\alpha \leq .05$ one-tailed (Kendall's Tau)
• = not computable

Table 20. Rank Order Correlations between Task PI and Number of Unsuccessful Attempts at Task EPIS Test; for CTS Tasks of the 35L Course

Task	r	n
1	.10	(54)
2	.02	(54)
3	.26*	(54)
4	●	
5	.23*	(54)
All Tasks	.24*	(54)

* = $\alpha \leq .05$ one-tailed (Kendall's Tau)
● = not computable

5. CTS Costs

As part of the CTS Operational Test Plan (September 1975), a cost model was developed that was to provide costing information for management and decision making. This model was designed for a summative evaluation of CTS costs with the intent of generating predictions or cost estimates of a complete, fully operational 500-terminal system (basically CAI in nature). No attempt was made to identify costs of alternative instructional approaches for comparative purposes--this was to be considered at a later date.

At the time our evaluation project began, cost data had been collected based upon the Operational Test Plan (OTP) cost model (i.e., costs were identified and categorized as described in this model). HumRRO had independently developed a cost-effectiveness specification for computer-based training systems (Seidel and Wagner, 1977). We intended to apply this specification to the CTS data. However, it was not possible, in most cases, for the cost data to be organized and analyzed within the framework of our specification. Rather, the cost categories developed by CTS (as described below) were used. Werever possible, guidelines from our specification (e.g., adjustments for inflation) were adhered to in calculating CTS costs.

Cost data were provided by CTS personnel for FY 1973 through FY 1977. As presented, the data were organized by capital, developmental, and operational costs for hardware, software, courseware and evaluation activities.

Development costs were those accrued during the initial development of the system.

Capital costs included all money spent for system contracts, course development, programming and USASC&FG personnel time.

Operational costs were those accrued during the actual operation of the system (this did not begin until FY 1977).

Personnel assigned to develop CTS instructional materials were required to keep daily records of the number of hours spent in each of a number of activities associated with the instructional development process. We were provided with copies of these "time logs" for all personnel for the years 1974-1977. These time data were converted to dollars by referring to the civilian and military pay scale tables appropriate to each fiscal year. All recorded costs for the CTS project are shown in Table 21. All contract costs were listed in the Capital Cost category. Fifty percent was added to salaries to cover fringe benefits, indirect, and other unrecorded CTS-related expenditures. This 50% factor was used to weight the base pay of civilian and military personnel. It was based, in part, on guidance from the Office of the Assistant Secretary of Defense (Comptroller), "Economic Cost of Military and Civilian Personnel," and recent policies of the Office of Management and Budget regarding civilian personnel pay. The following percentages of base pay were used in computing the cost of civilian personnel services.

Retirement	24.7%
Health Insurance	3.5%
Life Insurance	.5%
Holidays & Leave	16.5%
	45.2%

The remaining 4.8% was added to account for Government contributions to other benefits, and to cover other unrecorded CTS-expenditures. To adjust costs for inflation, a rate of 10%/year (using OSD guidance) was multiplied to each prior year's costs and summed over all years to arrive at the estimated total cost of CTS (see Table 21). The total cost of CTS by the end of FY 1977 is thus estimated at $7.5 million (in 1977 dollars).

Table 21. Recorded CTS Costs

	FY73	FY74	FY75	FY76	FY7T/77	TOTAL
Development						
Salaries						
Hardware	$ 34,508	$ 39,006	$ 25,202	$ 36,546	$ 10,558	$ 145,820
Software	34,754	39,438	25,202	36,546	21,641	157,591
Courseware	151,328	151,226	24,262	22,722	19,161	368,699
Evaluation	35,979	34,436	49,614	51,042	30,886	201,957
Σ Recorded Developmental Salaries	$ 256,579	$ 264,106	$ 124,280	$ 146,856	$ 82,246	$ 874,067
Capital						
Salaries						
Hardware	$ 8,747	$ 35,453	$ 21,695	$ 28,257	$ 708	$ 94,860
Software	8,747	35,800	21,695	28,257	20,776	115,275
Courseware						
31E		37,842	82,714	85,389	20,206	226,151
31J		37,842	72,682	99,941	34,724	245,189
31L		33,006	71,112	116,805	27,712	248,635
Evaluation		20,957	60,021	65,475		146,453
Σ Recorded Capital Salaries	$ 17,494	$ 200,900	$ 329,919	$ 424,124	$ 104,126	$1,076,563
Contracts	$ 40,974	$2,165,072	$ 120,875	$ 424,498	$ 240,130	$2,991,549
Operational						
Salaries						
Hardware					$ 19,799	$ 19,799
Software					26,370	26,370
Courseware					23,953	23,953
Evaluation					15,449	15,449
Σ Recorded Operational Salaries					$ 85,571	$ 85,571

ESTIMATED TOTAL CTS COSTS

Estimated Total Costs	FY73	FY74	FY75	FY76	FY7T/77	TOTAL
Contracts	$ 40,974	$2,165,072	$ 120,875	$ 424,498	$ 240,130	$2,991,549
Recorded Salaries (× 1.5)[1]	411,110	697,509	681,299	856,470	407,915	3,054,303
Yearly	452,084	2,862,581	802,174	1,280,968	648,045	6,045,852
Inflation Factor	$(\times 1.1)^4$	$(\times 1.1)^3$	$(\times 1.1)^2$	(× 1.1)		
Total CTS Costs (in 1977 dollars)	$ 661,896	$3,810,095	$ 970,631	$1,409,065	$ 648,045	$7,499,732 (end of FY77)

[1]50% added to Recorded Salaries for Fringe, Indirect, and Other Unrecorded CTS-related expenditures.

13. What administrative and personnel costs were incurred to establish in-service training programs?

A question of concern to the evaluation effort deals with the administrative and personnel costs incurred to establish in-service training programs for CTS instructors and for instructional programmers. While the instructional programmers were not privy to specific costs, nevertheless they were asked what classes or workshops they had attended in preparation for their jobs. Nearly all reported that they attended a one-week workshop on Class I given by the Data Systems Division and another Class I workshop of roughly the same length by the Digital Equipment Company. A number reported taking a week-long, in-house workshop on CAI where effective writing for CAI test development, and branching principles were emphasized.

Unfortunately, the time logs we received did not supply complete information describing "training" activities in FY75-FY77. A total of 1117 hours of personnel time (for 16 individuals) was listed as "in training" during these 3+ years. We are sure that this must be a partial figure and thus does not reflect the total cost (in time) of in-service training. We also did not receive the costs of the DEC contract for its on-site training program. In any case, based upon our knowledge of the situation, we feel that a very small amount of money was allocated for this purpose. As is pointed out elsewhere in this report, a comprehensive computer "literacy" program was necessary for assuring an adequate implementation of CTS. Such training was not made available to all concerned individuals--though it should have been and, in our opinion, should still be for any continued CTS operation.

6. Implementation Issues

Using the Chronological Chart of Significant Events (Figure 1) provided by CTS staff, as well as the annual reports, the acceptance test reports, and the CSSEA evaluation, a number of critical management decision points relevant to implementation are highlighted below. It can be stated at the outset that with all the policy changes that had taken place during the early stages of this effort, there was ample justification for delays at the beginning of the project. The purpose of the delays would have been to allow for alterations in the implementation plan to make the system installation and development effort more compatible with the new site, different project purposes, and new personnel at USASC&FG. The criticality of these early management decisions is that a dominoe effect was initiated and has been felt subsequently in all facets of the project. This effect prevents a meaningful evaluation of the system as a teaching tool.

Examples of the times at which management decisions were made that affected the course of the CTS project are as follows:

(1) In the latter part of April 1973, it was known that the Signal School at Ft. Monmouth was to be closed. On 4 May, there was a Bidders' Conference at Ft. Monmouth, and no mention was made of this change in location, nor were the system's performance specifications changed to accommodate a shift to a CMI purpose. Thirdly, there were new site personnel to be involved and their commitment and involvement in what was to be implemented at their School should have been recognized and obtained at <u>that</u> time. It was shortly after this critical time that some key personnel in the hardware/software area; e.g., Mr. Allyn Evans, Supervisory Computer Systems Analyst, and Mr. John Sintac, Computer Systems Analyst, selected other federal employment at Ft. Monmouth

rather than move with the project to the anticipated site at USASC&FG. It should be noted that Mr. Evans was the key person in setting the specifications for the CTS system. Mr. Evans did return to the CTS project some 6 months later (August 1974 to February 1975), and eventually moved with the PMO, CTS to Ft. Eustis, Virginia, in July 1975.

(2) It was not until 16 July 1973, that three proposals were received. At this time, a delay of another month or so for all three potential contractors would have permitted them to address the new requirements.

(3) Another critical decision point occurred with the initial establishment of the CTS Field Office in March 1974. At this time, there should have been a computer literacy training program undertaken with the various management level personnel of the USASC&FG. The two broadest levels of literacy--awareness of the impact of computers on administration and knowledge of the effects of computers on the various curricula--should have been established to facilitate adoption and cooperation by the School personnel.

(4) Another critical item at this time was to establish within the School a single chain of command having both the authority and responsibility for the system. There should not have been established, as noted in the Background section of this report, a dual and relatively ambiguous chain of command, vis-a-vis, the project structure and the school structure.

With the help of Mr. Frank Giunti and Mr. Donald Kimberlin of the Communications Technology Office at Ft. Eustis, we have charted the structure of the CTS Field Office responsibility and the School responsibility as it pertained to the development and implementation of course materials within the CTS framework. These relationships are provided in Figure 2, p. 18. This dual structure led to administrative ambiguity over course development.

A temporary resolution of course development responsibilities occurred when an ADP officer took a strong position on course development. He juggled three courses assigned in two different academic departments while he was the ADP officer assigned to a third non-academic, but support department. He left in mid-1976. His prime duty was ADP officer for the USASC&FG. There was no clear-cut line of authority in USASC&FG to manage course development. The nominal task leaders were, with the exception of the present one, ADP specialists with CTS course development responsibility as an additional duty. During this critical period, two key people assigned with the responsibility of coordinating the USASC&FG course development effort were each given a one-year sabbatical during the period September 1976 to December 1977, a most critical period in the life of the CTS project.

At that point, two critical stages in the CTS project had already been reached, both related to integration of CTS as part of the ongoing training effort in the School. Again, as noted in the Background section, the approach at Ft. Monmouth was oriented toward a laboratory R&D prototype system implementation. However, expectations at Ft. Gordon were for meaningful cost-effective results that reflected the nature of the CTS prototype with the ongoing operational requirements of USASC&FG.

(6) Throughout the history of this implementation, it is also not clear as to why courses were chosen that were previously systems engineered and self-paced, thereby already having resulted in a large time savings. With the cooperation, control, and commitment of the School, a more conducive home for a prototype CMI system would have been a lock-step course plagued by instructional deficiencies. Ideally, there should be an entire, experimental site in which to test out any prototype computer-based training systems.

(7) Another item critical to the need for delay and re-evaluation of the entire project occurred between April and June of 1975. This was the need for a communications study to be accomplished. It required a study of how cabling might be installed to connect the different buildings in which the terminals were to be housed. Again, multiple buildings represented a change from the original plan. It would have been perfectly legitimate and, indeed, desirable to have a delay of another two to three months at this time to take stock and reassess the progress and direction of CTS.

(8) In the software area, it was noted on the Chronology Chart (Figure 1) that the designation of personnel for a CTS Field Office occurred in August of 1974, between the Phase I and Phase II acceptance tests, and that the Field Office was not fully staffed until May 1975. Inasmuch as the applications programming was to be accomplished at the CTS Field Office, it would seem that a delay in the acceptance test--the second phase was run in February 1975--would have been appropriate.[1]

(9) There were a number of solid attempts to record costs despite all the personnel turbulence. However, the individual who organized the costing side of the project was transferred prior to the completion of the data gathering activities. The result was that information was not gathered as comprehensively and completely as it might have been.

(10) The last item to be mentioned in the way of critical incidents relates to the fact that the first students were started on the CTS system (31E course) in January 1977. But from the data gathered by HumRRO in the structured interviews and from the data collected from the system printouts, the

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[1]See page 6 of the third year status report regarding systems applications and programming staff discussion, Kimberlin, 1 August 1975.

software was still not stable and, therefore, the courses should not have been started even at that late date. If there is a single lesson to be learned from a prototype implementation involving new hardware and software, as well as course development--it is that there is a serial requirement that must be met. That requirement can be stated as follows: *The hardware and software must be in place and reliable prior to any attempt to run students on the system.* Moreover, the development of course materials on the system requires a stability in the interactive relationships needed between the authors and the system. This period of criticality occurred in January 1977 and exists until the present time.

Suffice it to say, that the criticality of the incidents as noted above emphasized the need for delays to plan the approach for a proper implementation of CTS. One item which we have not emphasized but which should be noted is that the preliminary evaluation plan was established in January of 1974; a consultants' conference to provide comments did not occur until almost one year later, December 1974; and it is not clear that the consultants' recommendations were fully implemented because of the tight time frame of the entire project. If reasonable delays had been requested, then it is quite possible that the consultants' recommendations would have been implemented in a more appropriate fashion, and that the operational test plan would have reflected changes in the system and facilitated its implementation.

12. What special qualifications are required by the instructional support staff.

Most of the responses to this question in our interviews were centered on instructional programmers and IPES. There was considerable agreement that the qualifications required in order to perform instructional programming include: subject-matter expertise, knowledge of the CLASS I language, knowing how to communicate effectively in writing, and knowing the computer system and what it can do for the instructor and the instructional programmer. In addition, most of the authors agreed that knowledge of how to develop CAI and to some extent self-paced instruction is very useful. This included knowing how to employ branching, knowing how to debug instructional materials, how to validate them, and how to evaluate them.

Most of the instrudtional programmers agreed that the principal requirement for IPES is knowing how to type. Two said they have to know the CTS keyboard, and one instructional programmer said that they need to use the editing commands in order to enter graphics. Comments on computer service personnel were very limited. The only substantive qualification stated by an instructional programmer is that the computer service personnel should be familiar with the courses and understand the problems of the instructional programmers and the instructors. Another remarked that a special requirement for computer personnel is "patience."

14. What unanticipated side effects or by-products can be attributed to the implementation of CTS?

One of the most important and yet often overlooked parts of evaluation, expecially in the formative sense in which we are concerned in this study is the unanticipated results that can be attributed to the prototype system. In the current implementation there were two side effect reports generated. The first at the end of October 1976; and the second in 1977, virtually a year apart. It is important to note that the first side effects survey was accomplished at a time when the acceptance of the system had just taken place.

In this section we will attempt to summarize these effects in narrative form, and to note changes if any between the first and second survey. The individuals supplying the information for this survey were the Chief of Data Systems Division, the Director of the Communications-Electronics Department, the Director of the Specialized Communication Electronic Equipment Department of the USASC&FG and other personnel within that Department.

There was an apparent lack of pre- and post-types of information from the same personnel. This means that whatever statements, inferences, implications, or conclusions can be drawn from the side effects reports must all be considered highly speculative at this time. Unanticipated effects can be either beneficial or negative with respect to innovation. The questionnaire as distributed by CTS personnel stressed negative effects and therefore some benefits which might have been discussed by the respondents were excluded.

The comments in the initial 1976 reports suggest a need for better management of the CTS implementation. They suggest a single line of command and the need for more adequate definition of responsibility within such a project.

Other comments in the 1976 reports indicated a problem in instability of course materials and of hardware and software. It appears that none of the individuals surveyed expected a prototype implementation. Rather, they were expecting an operational curriculum along with operationally stable hardware and software. In fact, many of their suggestions for improvements relate to just these points.

A concern in both administrations of this survey was for greater training and familiarization both at the instructional programmer level and at the management level for all persons who might be involved in such an implementation. These suggestions also support the previously discussed implementation issue of orientation and technical literacy training with respect to the CTS computer system. A point related to this need for computer literacy is clearly indicated in one of the respondent's forms. This individual felt that CTS will continue to have adverse effects such as "increasing the training time for each student," and "increasing the course failure rate." The training literature on CAI and self-pacing clearly yields opposite conclusions to this statement. The point here is that the individual respondent is making an incorrect inference based upon a lack of adequate orientation and pre-training in areas of CAI, CMI, and individualization of instruction. In addition, this individual is also reflecting a lack of understanding of the difference between an operational course already debugged, formatively evaluated and stable, as opposed to a prototype computer based training system that was not stable during its period of implementation.

The 1977 survey essentially supports the same notion of a premature implementation based upon operational expectations of the users. In addition, the fact that different individuals have filled out the questionnaires from

year to year emphasizes the problem of personnel turbulence. What is stipulated is a need for course development and other CTS-related personnel to be trained and retained in the same positions until the system is stabilized to make certain that the project is successful.

The instability of the course structure and POIs caused confusion in the minds of the personnel who developed course materials. They wished to keep such changes to a minimum until the course had been fully implemented. In any operational system this clearly would be required.

There were also some technical suggestions made, such as the need for some means of projecting a picture or secondary visual at the student terminal. That is, the need for graphics devices was highlighted. Also, the need for improved disk allocation or disk space was mentioned. It is important to note that such changes could have been made. The point here is that some of these technical decisions could have been made had the proper management been available during the course of the project. There was no one responsible for insuring that timely changes were made as required within the project. Thus, some of the technical problems could have been solved with the current hardware had the authority and responsibility been invested in a single individual.

E. CONCLUSIONS AND RECOMMENDATIONS

This section of the report is organized into three major sub-sections. First, we will summarize our evaluation findings--by major area of concern and within each area, by the relevant evaluation questions we sought to answer. Second, we will discuss the possibility of cost-effectiveness projections for CTS if it were to be used as a CMI system devoted to handling all the administrative needs of the USASC&FG. Finally, we will present a section in which we describe the lessons that were learned from the CTS project along with guidance for those who wish to implement computer-based or any other innovative training systems.

1. Summary of Evaluation Findings

In this section we will summarize our findings for each of the six evaluation areas covered in our study. Within each major area of concern, the relevant evaluation questions will be briefly addressed.

Technical Effectiveness

The CTS hardware/software configuration of six minicomputers with 128 CRT terminals was not designed to optimally meet requirements for computer-managed instruction at Ft. Gordon, or other Army training installations. Some key instructional management functions are not being supported even though the current hardware is underutilized. One or more of the DC's could be modified to directly support CMI functions. Once such changes are made, an analysis of the CMI utility to the whole school of CTS could be performed.

CTS Course Development

Instructional materials and logic development for CTS follows a systematic iterative process which begins with document review, selection of subject matter for on- or off-line presentation, and flowcharting student/system interaction. Having developed these detailed specifications, the Instructional Programmer (IP) prepares the actual on and off-line content and logic. Then, either personally or by delegation to a specially trained typist, enters the materials into the CTS computer. Subsequent steps in the development process entail review, debugging, and revision based on (1) evaluation by other instructors and IP's, and (2) the on-line, interactive experiences of advanced and naive students. Once the material has been "shaken down" it is incorporated with ongoing instruction.

How much time is required to prepare the training and test materials contained in the operational self-paced course annexes to CTS instructional materials?

On-line materials accounted for about 11.7% of the POI hours contained in the three courses. However, of the 55,000 hours spent in materials development, approximately 65% was devoted to preparation of on-line materials. According to IP's interviewed, on-line development activities consisted of original authoring, review, debug, and revision rather than conversion or modification of existing self-paced materials.

What feedback is available for you to use in revising instructional materials and tests? How has it been used? What additional feedback is necessary? How would it be used?

The principal sources of feedback were:

- student comments in the classroom
- IP observation of students and instructurs
- review of their materials by other IP's.

Very few IP's reported making consistant use of either CTS-generated reports or manual records. This is related to the finding discussed earlier on page 51 that only 20% knew about the five CTS reports.

For the most part IP's were not able to articulate a systematic procedure for identifying specific problem areas in the instruction or for correcting material based on feedback. Suggestions for additional types of feedback were virtually absent.

What is the average development time (hours) required for one POI hour of instruction in the CAI/CMI mode?

The average number of course development hours per hour of on-line instruction for all courses was 175; the range was 144:1 (35L) to 197:1 (31J).

What difficulties have been encountered in fitting the previously developed self-paced instructional materials into the CTS instructional model?

Instructional Programmers reported that little difficulty was experienced in coordinating the existing self-paced materials. This is to be expected because the older materials were retained in an off-line format. Required on-line materials were developed from scratch. The minor problems which did occur resulted from detailed work associated with ensuring the smooth coordination of on- and off-line instruction.

To what extent does the system enable timely modification (e.g., due to POI changes), revision and validation of course materials?

IP's believe that the CTS system enhances the effectiveness and efficiency of the validation of instruction. Opinions concerning the value of CTS in support of materials revision were divided; about half reported difficulty in making revisions. Finally, the majority of IP's did not believe that the CTS review/revision process reduced the time required to introduce materials into the classroom.

What special problems, if any, were encountered when entering (inputting) training materials on-line?

Frequent or intense problems associated with inputting training materials included:

- inability of Instructional Program Entry Specialists (IPES)--specially trained clerk/typists--to work effectively and without supervision
- inadequate IP training in the CLASS I language[1]
- a number of acute system hardware/software problems resulting in loss of stored materials, slow-down of the debug-revision process, and delays in course implementation.

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[1] EDITOR commands, a subset of CLASS I, were used to enter the materials.

CTS Course Administration

An extremely important function of the CTS is to relieve the instructor of many administrative and record keeping responsibilites so that he can concentrate his efforts on providing precise, timely attention to unique student learning problems. To this end the designers of CTS incorporated system generated reports, system monitoring of routinized student progression through the instruction, and maintenance/monitoring of instructional resources to optimize their availability in the classroom.

Below we summarize findings on the success of the computer-based administrative support.

How useful are the CTS-generated reports for instructors and training managers?

Six CTS reports provide information on the degree to which students, as a group, have been successful in mastering course content; these include the Course/Task Report, the TAIS Report, and three reports presenting data on EPIS and pre/posttests. Twenty percent or fewer of instructional personnel canvassed were aware of these reports; however, those few who were familiar with them regarded the forms positively. Most personnel were familiar with reports related to student scheduling and throughput (e.g., Class Roster, Student Activity Report, and Graduation Prediction). For the most part opinions concerning the accuracy and utility of this class of reports were favorable.

Has the system been effective in monitoring students within the respective Tasks/Annexes?

Instructors report that under "normal" student flow the system can route the student from Task to Task through the course and indicate his position with few problems or errors. The system is considered less capable of routing students when the demand for equipment and practice stations becomes intense.

Instructor opinion is divided on whether CTS reduces their responsibility and workload in the areas of routing students and keeping related records.

Were sufficient resources available to handle the student load?

From all available evidence, it appears that CTS resources were able to handle student throughput. No untoward queueing occurred at computer terminals and student interactions took place when required.

Is there an adequate back-up capability to provide instruction during computer down-time?

As a result of our observations and interviews, we believe that on-line instruction comprised less than 12% of the courses and, as such, instructors were not overtaxed when CTS was inoperative. Available back-up materials were sufficient to ensure the continuation of instruction during computer down-time.

Training Effectiveness

What is the average student progression index by Task and Annex for each CTS course? What is the standard deviation? How many graduates were there in each course?

The average student progression index for CTS students in the 31E Course was 1.11 while that for self-paced students was .84. For the 31J Course the average PI among CTS students was 1.01; the average for self-paced students ranged from .98 to 1.08 depending on the POI in effect. The average PI for both CTS and self-paced students in the 35L Course was .96.

The 31E Course graduated 205 CTS students during FY 1977 and 97 more in the period October 1977 - March 1978. In the 35L Course, 70 CTS students graduated in the period July 1977 - May 1978. Eight students have graduated the 31J Course since its CTS tasks were declared operational.

What was the number and percentage of students who failed to graduate from each CTS course?

In FY 1977 the 31E course lost 22 students for academic reasons; the same number were lost during October 1977 to March 1978; total losses are about 11%. In the 35L Course eleven students failed to graduate during the period July 1977-May 1978, around 12 percent.

What are student attitudes towards CTS courses?

Student responses to a survey on CTS (see pp. 97-98) revealed that the majority found more to dislike about this instructional mode than to like. Students believed the instruction too hard, the instructors less available than they should be, and the variety of media difficult to work with. They also considered system down-time and shortage of terminals an impediment to learning. About two-thirds said they would not prefer more instruction delivered via CTS.

What is the relationship between student scores on CTS administered Task tests and Progression Index values? What percentage of students passed CTS tests on the first try?

Available data indicate that CTS students pass Task tests on the first attempt somewhat more frequently than their self-paced counterparts. In the 31J Course CTS students experienced a considerably higher first-try success rate in the majority of comparable tasks. Success on the first attempt at Task tests in the 35L Course was high for both CTS and Self-Paced students with the exception of one Task where 100% of CTS students passed on the first try as opposed to 72% of Self-Paced students. Comparisons were not possible for the 31E Course because no data was available for Self-Paced students; none-theless at least 80% of CTS students passed the majority of 31E task tests on the first attempt.

Statistical analysis indicates significant positive correlations between number of Task test "NO GO's" and size of Progression Index for each CTS course. It is suggested that required remedial sequences following Task Test failure in CTS courses may account for the relationship.

CTS Costs

Costs and personnel time data provided to us by CTS personnel were organized into Development, Capital, and Operational categories established by their Operational Test Plan (OTP) cost model. Total costs of CTS for the period FY 1973-FY 1977 (in 1977 dollars) was estimated at $7.5 million.

> *What administrative and personnel costs were incurred to establish in-service training programs?*

From only partial data, we estimate that approximately 1100 hours (16 individuals) were accounted for by in-service training programs. However, we feel that one should attach considerable importance and resources to such training in order for an implementation such as CTS to be successful.

Implementation Issues

Management decisions made early in the CTS project have affected its course until now. Some of the decisions that are critical to a successful implementation are listed below:

- Once the change in site and purpose becameknown, the CTS project should have been delayed to permit alterations in system performance specifications.

- Once the site shifted, a computer literacy training program should have been undertaken for USASC&FG personnel at all levels.
- A single, not dual chain of command should have been established within the USASC&FG that would have had the authority and responsibility for the system.
- Due to the hardware/software instability even as late as January 1977, no on-line course development or actual student interactions should have begun even then. A serial development of CTS should have been required, even if delays had to be requested.

What special qualifications are required by the instructional support staff?

Respondents agreed that data entry specialists had to know how to type. Instructional programmers required subject-matter expertise, knowledge of the CLASS I language, writing skills, and computer literacy.

What unanticipated side effects or by-products can be attributed to the implementation of CTS?

Only the problems or negative effects were obtained by the survey--namely:

- lack of clear management
- instability of hardware/software and course materials
- lack of adequate training for instructional personnel related to computer based training
- personnel turbulence

2. Cost Effectiveness

Projections

As part of our study goals, we were to perform a predictive cost analysis of CTS assuming the system was to be replicated. However, insufficient operational cost data were available to make any valid cost projections. Also, no direct comparison between CTS and the self-paced courses was possible as costs for the latter were not calculated.

Regarding such cost-effectiveness ratios, any projections calculated during the initial development stages of the training system should be treated with caution as they are subject to much error. This is especially true when a prototype hardware/software system is undergoing modification. One should adopt an approach that will accumulate cost-effectiveness data on a continuing basis throughout the life cycle of a project. Data collected during the Development Phase should be used in a formative manner--for system revision and improvement. Data collected during its Operational Phase could then be used to provide more reasonable and valid projections for decision-making.

A cost-effectiveness analysis should be performed on training systems when they are fully operational. However, as our study of CTS indicates, one of the three courses on the system was still not operational by the time our data were collected. Thus, CTS was in a Development Phase at the time cost data were collected. Projections based on these data must be considered hypothetical. The costs and effectiveness data that were gathered while CTS was under development were influenced by many factors that would not occur in a more stable environment.

A comparison of alternative training systems on the basis of costs and/or effectiveness is meaningful only if the systems contain courses with similar objectives, content, testing conditions and criteria. The self-paced and CTS versions of the 31E, 31J and 35L courses do not meet all these comparability criteria, and thus the comparisons made in this report are tenuous at best.

It is inappropriate to try to retrofit a cost-effectiveness model and subsequent analyses on data collected when implementing another model that was designed to meet another purpose. The cost model prepared in the CTS Operational Training Plan (OTP), September 1975, was designed for evaluating the cost-effectiveness of a CAI system. The cost-effectiveness ratios identified in that document such as Hourly Instructional Cost are valid for that use of the computer. However, once a CMI purpose was imposed on the system--a different cost-effectiveness index would be more useful [e.g., graduation cost (cost per student)]. In either case, CTS would not be cost-effective unless the personnel who are to be replaced by the labor-saving assistance of the system are, in fact, replaced. If not, then no large system such as this can ever be judged cost-effective.

The total CTS costs described in the previous section of approximately \$7.5 million would not need to be duplicated if another system with identical specifications, software and courseware, were to be developed/purchased. However, CTS personnel have indicated that they would redesign the configuration with less expensive hardware/terminals. Approximately \$<u>1.5 million</u> was estimated to be needed to replicate the CTS hardware/software system. In addition, a courseware development/evaluation effort would be needed (estimated at \$<u>1.85 million for 3 courses</u>). Such high investments would need to be amortized over the useful life of the system (8 years for the hardware/software; 4 years for the courseware). This means that approximately \$650,000 of amortized cost needs to be accounted for each year.

Other operational costs would include the salaries of those personnel required to operate the CTS. Such personnel would include a Systems Analyst (First Lieutenant), a Programmer (E6), an Administrator (GS-12) serving as an interface with USASC&FG personnel, a Console Operator (E4), and part (1/3) of a Shift Supervisor's (GS-7) time. The yearly salaries of this team would be approximately $104,315 (fully burdened with a 50% factor). The number of personnel who would be replaced by the system to handle 3 courses would only account for $72,000 or less than 70% of the additional cost to operate CTS.

It may be that if CTS was to be used in a CMI mode exclusively--no on-line instructional interactions--then administering the schedules of 6000-8000 students could be economically justified. The COMTRAINS report (Appli-Mation, 1978) predicted that the current CTS system could handle an on-board training load of 6000-8000 students at USASC&FG, if the system was to be used entirely in a CMI mode. Such a use has not been evaluated, nor have the necessary additional courseware/software costs been calculated.

In making cost-effectiveness projections, we need to consider all appropriate costs and benefits during the operational life of the system. Thus, the total costs that may be avoided during this period (e.g., additional personnel to handle an alternative system) need to be considered in judging the potential value of the CTS.

The numbers in Table 22 reflect the maximum load that needs to be managed by CTS in a purely CMI mode (i.e., no instructional interactions or testing). It was not the focus of this project to analyze the cost-effectiveness of such an application, but to point out that it has been estimated that only $72,000/year in administrative costs could be saved (personnel salaries) by CMI implementation of CTS in the three courses discussed. However, we do not know the total level of personnel reduction if all of the courses at Ft. Gordon were to

be self-paced and required manual scheduling and management. The issue here is one of cost avoidance, as it is highly probable that additional personnel would have to be hired to do this work. A careful analysis needs to be done to determine the additional software and/or hardware necessary to handle all Ft. Gordon's self-paced course management by CTS and whether this extra expense is less than that of a comparable manual operation. Only then can this issue be resolved.

Table 22. Estimated Input and Training Load for Ft. Gordon

	FY78		FY79		FY80	FY81
Total	Input	Average Training Load	Input	Average Training Load	Input	Input
Ft. Gordon	29,426	6288	29,502	8814	33,025	32,133

3. Lessons Learned/Guidance

Is CTS a Technically Effective CMI System?

One of the most frequently asked questions of us as evaluators has been: "Is the CTS hardware/software configuration adequate for the Army's CMI needs either at Ft. Gordon or at other Army installations?" It is the case that CTS probably has sufficient CMI capacity for handling the scheduling, administration and record keeping of all the students in a self-paced mode at Ft. Gordon. However, we did not investigate this matter directly but must rely on the CSSEA (1977) and COMTRAINS (Appli-Mation, 1978) reports for their conclusions. Both reports suggest that with some modifications to the software and with additional hardware links, the current system could provide sufficient capability for all of Ft. Gordon's CMI needs.

In our study we learned that the system did not provide the kind of reliable feedback that would give the instructors confidence to use the system. However, much of what happened was a result of the inherent instabilities of a prototype system, management ambiguity, and administrative difficulties. For example, on the technical side, one of the problems that people using the system complained about was that only one course could be on the system at any one time for authoring purposes. The fact of the matter is that this occurred because there was simply not enough disk space allocated to instructional development. While there was limited disk space for development due to the systems design, there was management of the available resources. In the development process, USASC&FG was faced with two alternative procedures for allocating disk space and system time. One was to give each course a small amount of disk space, but allow all courses on-line at the same time. The

other was to allow one course at a time on the system, but give them more work area on the disk. Both alternatives were used during the development process. Early in the process all courses were allowed to work on-line at the same time because an IP needed to work longer on one lesson unit. As development progressed, the other procedure was used because the IP needed access to many units for minor revisions.

Also, there was no one management group or manager responsible for the CTS training development within the School itself. Such management responsibility should be vested in one individual in the office of the Deputy Commandant who would, in turn, be responsible to the Commandant of the School. That person would then have authority over the various support facilities, including the Data Systems Division, as well as the Departments and instructor personnel.

Would a CTS CMI System be Cost Effective?

Whether or not CTS is or would be cost-effective will depend on the alternative manual system against which it is compared. For example, could onboard personnel handle the planned administrative requirements for self-pacing at Ft. Gordon? If so, how many current personnel would be replaced by the computer? If not, how many additional personnel would be required? The cost-effectiveness conclusion would also depend on the replacement of current terminals in the CTS configuration by less expensive, more suitable equipment for CMI purposes. The requirements for such minimal hardware and software changes nevertheless must be costed in order to determine if CTS can be an efficient system for CMI use at Ft. Gordon. The generalizability of this type of system for other installations is not recommended without a detailed analysis of the CMI needs at other installations and a comparison with other possible systems. With minimal CMI requirements, much less expensive system equipment

can be obtained. While this equipment may have less software capabilities they could be more cost-effective CMI systems depending upon the specific needs at other sites.

The following paragraphs describe the "lessons learned" in our evaluation of CTS and presents point to consider when planning an innovative training system implementation.

- Ensure that there is universal agreement (or understanding) on project purpose(s).

At the very beginning of the development of a conceptual plan the statements of project purpose will set the stage for expectations of potential outcomes. In this respect, the CTS project was originally to be considered as a prototype CAI system implementation. The staff and user expectations were established at Ft. Monmouth where the system was to be implemented in prototype form. The participants at that school were familiar with CAI as a result of their earlier studies. Moreover, their expectations were in fair agreement as to the potential outcomes. However, when the system was moved to Ft. Gordon a reestablishment of agreement on purpose should have been accomplished with new user and new staff personnel there. In the future many of the difficulties that have been documented in this report cam be ameliorated, if not totally eliminated, by consistent coherent planning and agreement on purpose.

- Make certain that the system design is compatible with the project purpose(s).

The requirements for a CAI system are different than the requirements for a CMI hardware/software system. For example, a CMI terminal may require compatability with optical scanning equipment. The power and configuration of the computer system will also differ depending upon whether it is a CAI or CMI system. In the CTS project, the hardware/software design was originally stipulated to be a CAI system with a certain percentage of graphics and a

large percentage of on-line interactive instruction. These requirements were totally changed when the implementation at Ft. Gordon was initiated. The purpose became that of CMI and therefore the hardware/software system should have been reconfigured to handle the new requirements and new purposes. In the future, management decision-making must be flexible enough to present hardware and software requirement modifications to handle the shift in purposes.

- Ensure that there is a serial development of critical system components.

One should sequentially organize the system development activities within a project of this type. Unlike the parallel system development events encountered at CTS, the following sequence for training system development should be followed. First, the hardware and software designs must be developed and implemented to a point where reliable and stable outputs are provided without any actual course materials on the system. Secondly, adequate provisions should be made within the contract, if an outside contractor is developing the system, for an appropriate job stream loading of software on the system to test relevant applications. It is only following the testing and debugging of the hardware and software that course development should proceed on the system. Some general off-line development of course materials could be initiated prior to the implementation on-line. However, it is not appropriate to do a great deal of course development work without knowing the formatting requirements and how the material will appear on the terminal device. If too much is accomplished before a terminal is available, then a good deal of revision will have to be performed and the course development efforts could suffer as a result. As sections of the instructional material are developed, they can be tried out and validated with selected students. At this time, too, the instructional model can be tested for consistency and adequacy on the system. Only after the materials have been formatively evaluated and debugged should the course and the

hardware/software system be exposed to actual operational trainees. Some of the negative attitudes on the part of instructors and frustrations on the part of the students in the CTS project could have been eliminated if this system development sequence had been followed.

- <u>Employ an evaluation model that is consistent with the project purpose(s)</u>.

An appropriate evaluation model is required that will <u>focus</u> the data collection. Determine whether the type of evaluation is formative in which case its purpose is to ensure that the system effectively teaches. This will entail an iterative process of development, debug, testing and revision of the course materials. Such should be the case in a <u>prototype</u> implementation. On the other hand, if one is in an operational mode, then a summative evaluation would be appropriate. In the case of the initial CTS purpose, the OTP included a cost-effectiveness evaluation based upon a summative evaluation of a CAI system. This was premature on two counts: (1) A formative evaluation was required at that time, and (2) when the purpose changed to CMI, a different evaluation model should have been designed. In the CTS implementation, the purposes were not universally agreed upon. It is clear that different expectations existed and as a result some of the School personnel expected a summative type of evaluation, yielding cost-effectiveness conclusions. The problem is that cost-effectiveness projections from a prototype system are subject to high error. In a prototype project, management should be aware of the pressures by training system sponsors who are hungry for evidence upon which to base their decisions, and should resist demands for a premature cost-effectiveness analysis. In the future the Army would do well to establish guidance for performing adequate and timely evaluations and for using evaluation models appropriate to the given project purpose. With respect to costing analyses, there should be adoption of uniform costing categories based upon whether or not the system is

in a development or an operational mode. A commitment must also be made at the project's outset for collecting such data in a consistent and comprehensive manner. Along with this guidance, effectiveness criteria should be established at the targeted implementation site upon which to evaluate the effects of training. In CTS training effectiveness could not be determined because system stability and effectiveness were not separatable from the training effects on students.

- Employ a staffing mix consistent with project needs.

In the case of CTS, a qualified interdisciplinary team required to perform the various hardware/software functions, instructional modeling, and course development was established early in the project. Such an approach should be continued in the future and the mix should be appropriate to the type of project. There is no need to have a large hardware staff if you are going to incorporate an already stabilized hardware system. A part-time consultant or contractor might be sufficient. On the other hand with respect to evaluation and costing analysis, there should be dedicated staffing for those purposes to include adequate support for data collection. If comparative analyses are to be made, then there should be equivalent support provided to collect data from the alternative training systems against which the innovation is to be compared. In the case of the CTS project, not enough resources were allocated for these functions.

- Permanence of key personnel is essential to timely completion of a complex project.

One of the problems the Services continually face is that of personnel turbulence. It is particularly critical that turbulence be held to a minimum when attempting to implement such a complex innovation as computer-based training systems. In the case of CTS when the change in site location occurred

there was a loss of key personnel familiar with the software and hardware as well as with the project's management process. In the future the Army would do well to provide sufficient extensions of duty tours to accommodate completion of such projects.

Training Site/Project Interface: Managing the Implementation

Key points to consider related to this area of concern are the following:

- Literacy and orientation program is required prior to site installation.

One of the most important problems to overcome is to insure that the users at the target site understand the nature of the computer-based innovation. Without doubt, the administration of a School and the required support for implementing high technology such as computer-based training will require an adjustment and accommodation that may be disruptive to the old way of doing things. The resistance to a large-scale innovation like CTS can be overcome by a tailored computing literacy program and orientation for all levels of management. Clearly, efforts are required in the hardware/software area to prepare a site for installation of the equipment. There is also a need to prepare site personnel for system implementation by having them understand what effects the computer will have on their activities. User personnel can, in turn, suggest new ways in which the innovation might be extended to accomplish other objectives. There can be a continual feedback of good ideas and cooperation once an initial understanding is accomplished. This must be done in the future if satisfactory implementation of any innovative system is to be accomplished.

- <u>Commitment, lines of control and participatory management involving the designated user site must be established prior to installation</u>.

The arrangements at Ft. Gordon provided support personnel and facilities to the CTS project. There was, however, no contribution of staffing and dollars and no degree of control over the project implementation. This resulted in the perception of CTS, as indicated from the various interviews and survey forms, as an outside imposition on the School. The <u>initial</u> Memorandum of Understanding (see Attachment #10) indicated that there would be no real control or authority by the School until the test and evaluation period was complete. In the future, a new training system implementation should be under more direct control and management of an informed and receptive user site.

- <u>A single chain of command for project management at the designated site is necessary</u>.

As noted earlier the CTS project had a dual chain of command with School personnel reporting to their chiefs, CTS Field Office personnel reporting to their chiefs, and the development of project products based upon cooperative undertaking from both sources. This duality was responsible for much ambiguity and lack of desire to take on responsibility. It was apparent in many of the interviews that no one was willing to take a risk and be held responsible unless absolutely necessary. Thus, only when a strong personality decided that something had to be accomplished was much direction given to project development. This must be avoided in the future. The Project Manager's Office must be maintained at the implementation site. It is our considered opinion that many difficulties could have been avoided in the CTS implementation if this had been the case. Without such collocation, ambiguities in communication will result.

- Integrate the chain of command (management) within the training directorate of the user site.

When implementing a computer-based training system at a School, a single person should be in charge who is located within the Office of the Deputy Commandant of the School. Teams are appropriate but the management has to be vested in one individual high enough up in the command structure of the School so that his responsibility is matched by the authority of the Deputy Commandant. Within the ISD context, representatives of each major activity should be involved. However, all should be under the overall direction and authority of a single individual. Support personnel are required from the computer science and engineering groups but they are indeed subordinate to the purpose of implementing a training system and should not be in a control position with respect to that implementation.

- Frequent meetings are necessary to monitor the atmosphere of expectation and understanding.

One must ensure that administrative and support personnel not only accept the fact of change but that they are allowed to express openly and frequently the problems that plague their work. Coordination of team efforts, the adherence to priorities, meeting various contingent deadlines, etc., require such meetings to be scheduled regularly and that continuous communication exist among the project management, contractors, sponsors, and users.

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Computerized Training Systems Directorate
US Army Training Support Activity

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ATTACHMENTS

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ATTACHMENT #1

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES CONTINENTAL ARMY COMMAND
FORT MONROE, VIRGINIA 23351

ATIT-STM 29 June 1972

SUBJECT: Computer Assisted Instruction Prototype Program Implementation

Commanding General
US Army Signal Center & School
Fort Monmouth, New Jersey 07703

1. Reference letter, ATSCC-DOI-CAI, HQ USASCS, 7 June 1972, subject: CONARC CAI Task Group Report, April 1972.

2. Based on the additional information contained in referenced letter, USASCS has been selected as the site for the CAI Prototype System Implementation.

3. The CONARC project manager (PM) for the CAI Prototype System will be designated from within the staff of the USASCS. The PM will manage the program for CONARC and also be executive secretary of the DA established CAI Steering Group. A list of members of the CAI Steering Group is at Inclosure 1 (Annex C-6).

4. Computer Systems Support and Evaluation Command will assist in the development of hardware specifications and will perform required competitive procurement actions in coordination with the PM.

5. Office of the Chief of Research and Development will provide applied research and development support for the CAI Prototype System Program. The extent and type of support to be provided are under negotiation.

6. USASCS is requested to identify the resources necessary to perform this mission:

a. Funds required will be identified by program elements and by fiscal year.

b. Justification for personnel essential to the operations of the CAI Prototype System will be submitted to this headquarters in accordance with CON Reg 1-45.

ATIT-STM
SUBJECT: Computer Assisted Instruction Prototype Program Implementation

7. This headquarters will be kept informed of the progress of the project through reports generated by the CAI Steering Group, and other reports as required.

FOR THE COMMANDER:

1 Incl
as

(SIGNED)
IRA A. HUNT, JR.
Major General, GS
Deputy Chief of Staff
for Individual Training

CF:
HQDA (DACS-CMS)

ATTACHMENT #2

COURSE MATERIALS DEVELOPMENT SURVEY

COMPUTERIZED TRAINING SYSTEM (CTS)

The purpose of this survey is to gather information concerning the development of Computerized Training System instructional materials for the 31E20, 31J20, and 35L20 courses. Please answer all items in this survey as factually and completely as possible, and with complete candor. Your responses will be held in strictest confidence. If you feel that you are not in a position to answer a particular item because you have not been closely associated with the CTS project, please circle the item number and leave it blank. Your comments or suggestions will be greatly appreciated.

Date ____________________

Please indicate (✓) your position relative to CTS:

a. Instructor ____________________ e. Division Chief ____________

b. Instructional Programmer _______ f. Education Specialist _______

c. Section Chief ________________ g. Training Specialist ________

d. Course Chief ________________ h. Other ____________________

PLEASE RECORD YOUR ANSWER OR CHECK (✓) THE ALTERNATIVE WHICH BEST EXPRESSES YOUR REACTION TO EACH ITEM THAT FOLLOWS.

COURSE MATERIALS DEVELOPMENT SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
SECTION I. Fitting Existing Self-Paced Training Materials into the CTS Model. 1. The instructional model is flexible enough to accomodate: a. Course strategies						
b. Subject matter.						
2. The CTS instructional model is compatible with the systems engineering of training requirements of course development.						
3. No revision of systems engineering of training documents was necessary to fit previously developed self-paced materials into the CTS instructional model.						
4. Introduction of on-line testing (pretests/posttests) required major revamping of learning units (lesson plans).						
5. The CTS model required little change in instructional materials because of the limited amount of on-line instruction.						

COURSE MATERIALS DEVELOPMENT SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
6. The CTS instructional model varied only slightly from the on-going instructional model.						
7. The CTS model was designed primarily for instruction in the CAI (student interacts directly with terminal) mode and does not lend itself well to a course that is heavily CMI (material presented off-line under computer management).						
8. Using the CTS instructional model has accelerated the conversion of training materials to the CTS mode.						
9. The CTS instructional model is especially adaptive for the use of multimedia lesson presentations.						
10. The CTS instructional model has sufficient latitude to accommodate the various learning alternatives utilized in the course.						
11. The CTS instructional model is designed to accommodate the dynamic training materials (where the learning path is determined by student performance rather than predetermined aptitudes).						

COURSE MATERIALS DEVELOPMENT SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
12. The CTS instructional model enables the system to make decisions concerning student progression that were formerly made by the instructor.						
SECTION II. Problems Encountered when Entering Training Materials on Line. 13. Instructional programmers must oversee the input of course materials by Instructional Program Entry Specialist (IPES) and/or Clerk-Typists.						
14. Delays were experienced in entering instructional materials on-line because of the shortage of clerk-typists and IPES personnel.						
15. Clerk-typist/IPES personnel experienced little or no difficulty in entering lesson material or logic coding into the system.						
16. The amount of CAI in the course has been limited by the programmed (4-1) student to terminal ratio in the classroom.						

COURSE MATERIALS DEVELOPMENT SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
17. Compiling the lesson material after being entered on-line has caused considerable delay in loading the courseware into the system.						
18. To effectively prepare a unit of instruction, the same Instructional Programmer should be the author, complete the logic coding, enter (or supervise the entry) of the material into the system and accomplish debugging.						
19. Logic coding of lesson materials has caused relatively few problems when entering materials into the system.						
20. Editing materials on-line has been compounded by IPES/clerk-typist typing errors.						
21. Little difficulty was experienced when deleting or adding new or revised CTS instructional materials on-line.						
22. A complete CTS unit of instruction can be changed overnight eliminating any delay in student progress.						

23. The average waiting time (queue time and compile time) for the system to compile an instructional Class I source code has been

a. _____ 10 minutes

b. _____ 20 minutes

c. _____ 30 minutes

d. _____ 40 minutes

e. _____ 50 minutes

f. _____ Other (show time)

24. What problems were encountered when inputting and "saving" lesson material during the process of entering courseware on line?

25. How much adverse effect, if any, has computer down time had on entering of materials on line? Explain.

26. In your opinion, what are the advantages and disadvantages in using the CTS instructional model when converting existing training materials to CTS?

Advantages	Disadvantages

27. What is your frank opinion concerning the relative worth of the CTS instructional model?

28. Did waiting for system restarts delay the preparation of instructional materials? Explain.

29. What special problems did you encounter when logic coding lesson materials?

30. Was there any limitation to the number of IPES's that could enter materials into the system simultaneously?

Yes _____ No _____

If yes, what was the limitation?

31. If the answer to item 30 above was yes, how did this hamper the loading of courseware into the system?

COURSE MATERIALS DEVELOPMENT SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
SECTION III. Test Analysis.						
32. On-line pretests are effective in diagnosing student knowledge of the instructional unit.						
33. The results of the pretests are good predictors of student accomplishment.						
34. On-line pretests are not a factor in routing students through the course.						
35. On-line pretest results have little impact on student performance.						
36. Since pretests are optional, most students elect not to take the pretest.						
37. Of the students who elect to take the pretests, the majority fail.						
38. Posttests have been effective in measuring student accomplishment.						

COURSE MATERIALS DEVELOPMENT SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
39. Distractor counts have identified weaknesses in the instructional material per se.						
40. Pretest and posttest distractor counts have pinpointed deficiencies inherent in the test questions.						
41. Posttests have proved to be highly successful in routing the student into his proper learning alternative.						
42. Distractor counts have enabled instructional programmers to make timely revisions to questions and training materials.						
43. Because of misspelling and improper phrasing, more unanticipated responses have surfaced than expected.						
44. Unanticipated responses are useful when revising instructional material.						

45. How can test distractor counts and collection of unanticipated responses be used to revise training materials?

COURSE MATERIALS DEVELOPMENT SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

SECTION IV. Conversion of Training Materials to CTS.

This section will focus on the conversion of existing instructional materials to the CTS instructional mode. The task will be the basic instructional element for analysis. Two areas will be addressed: (1) tasks with the greatest number of hours of CAI, and (2) tasks devoted primarily to CMI.

46. Please show the break out*of CAI (on-line instruction and testing) and CMI (off-line instruction under computer management) within your course.

SPECIAL NOTE: One hour of CAI or CMI is construed to be that amount of instructional material programmed to be completed by the student, with an average Progression Index (P.I.) of 1.00, in one academic (50 minutes) hour.

Course: (circle) 31E20 31J20 35L20

Academic Hours in Course: (Do not include COBET) ________

Task #	Hours in Task	Hours in CAI	Hours in CMI
1	________	________	________
2	________	________	________
3	________	________	________
4	________	________	________
5	________	________	________
6	________	________	________
7	________	________	________
8	________	________	________
9	________	________	________
10	________	________	________
11	________	________	________
12	________	________	________
13	________	________	________
14	________	________	________

*Refer to Course Profile

COURSE MATERIALS DEVELOPMENT SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Task #	Hours in Task	Hours in CAI	Hours in CMI
15	______	______	______
16	______	______	______
17	______	______	______
18	______	______	______

47. Was it necessary to accomplish any/all of the following actions in converting existing self-paced instructional materials to CTS? If yes, explain.

	Yes	No	Explain
a. Minor changes to lesson material.			
b. Major revision of lesson material.			
c. Complete rewrite of lesson material.			
d. Delete selected material.			
e. Develop new material.			
f. Add progress checks. (pretest/posttest)			
g. Reprogram utilization of A-V devices.			

SECTION IV. Conversion of Training Materials to CTS.

48. Based on CTS time logs, request the time required for conversion of training materials of four tasks (familiar to you) to CTS be calculated as indicated below. Select a medium length and long task containing the greatest number of CAI hours, and a medium and long task devoted primarily to CMI for time analysis.

a. Long Task - CAI

Task No.	Hrs in Task	Hrs CAI	CTS Instructional Materials	Time Spent
			1. Unit Development (Include all on-line material)	
			2. Logic Coding	
			3. Editing and Debugging	
			4. Review and Revision	
			5. Other	

b. Medium Task - CAI

Task No.	Hrs in Task	Hrs CAI	CTS Instructional Materials	Time Spent
			1. Unit Development (Include all on-line material)	
			2. Logic Coding	
			3. Editing and Debugging	
			4. Review and Revision	
			5. Other	

c. Long Task - CMI

Task No.	Hrs in Task	Hrs CAI	CTS Instructional Materials	Time Spent
			1. Unit Development (Include all on-line material)	
			2. Logic Coding	
			3. Editing and Debugging	
			4. Review and Revision	
			5. Other	

d. Medium Task - CMI

Task No.	Hrs in Task	Hrs CAI	CTS Instructional Material	Time Spent
			1. Unit Development (Include all on-line material)	
			2. Logic Coding	
			3. Editing and Debugging	
			4. Review and Revision	
			5. Other	

COMMENTS:

SECTION V. Time Required to Prepare One Hour of CAI (on-line instruction and testing).

SPECIAL NOTE: One hour of CAI is construed to be that amount of instructional material programmed to be completed by the student, with an average P.I. of 1.00, in one academic (50 minute) hour.

49. Based on CTS time logs, in a task that includes 9 or more hours of CAI, what was the average conversion (the adaptation of on-going self-paced instructional material to the CTS mode) time per hour of CAI? Explain.

50. Based on CTS time logs, what was the average conversion (the adaptation of on-going self-paced instructional material to the CTS mode) time for one hour of CAI, exclusive of testing. Explain.

51. What is the average conversion (the adaptation of on-going self-paced instructional material to the CTS mode) time required to enter one hour of CAI (include testing) on-line, debug and validate the material?

52. What is the difference in the conversion (the adaptation of on-going self-paced instructional materials to the CTS mode) time required to enter, debug, and validate an hour of CAI instruction that includes testing and one that does not? Explain.

53. Do the time estimates in paragraphs 49 and 50 include the basic research (initial development of training material not previously presented to the student) required to prepare an instructional unit, or are they conversion factors only?

54. If just conversion factors, how much additional time must be allotted to accomplish the basic research (initial development of training material not previously presented to the student) required for one hour of CAI?

55. Based on your answers to questions 49 through 54, what is your best estimate of the total time required to prepare one complete hour of interactive CAI, exclusive of any testing? Explain.

56. Do you feel the time estimate cited in question 55 would apply to all segments of instructional material? Explain.

57. Do you believe the time estimate given in question 55 can be used with reasonable accuracy to predict future CAI development requirements?

COURSE MATERIALS DEVELOPMENT SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

SECTION VI. Time Required to Develop One Hour of CAI.

<u>SPECIAL NOTE</u>: One hour of CAI is construed to be that amount of instructional material programmed to be completed by the student, with an average P.I. of 1.00, in one academic (50 minute) hour.

58. Based on your time estimate, in answer to question 49, show the breakout of time required to convert one hour of self-paced training material to CAI.

Breakdown of Time to Complete One Hour of CAI	
Item	Your Estimate Hours
a. Planning, strategy, lesson unit outline	
b. Authorizing text (writing, typing, coding)	
c. Training aids, photography, graphics	
d. Debugging, revisions, evaluation, coordination	
e. Small and large group validation	
f. Reference literature, advanced worksheets and special texts	
Total Estimated Hours	

ATTACHMENT #3

REVISED AND ALTERNATE TRAINING MATERIALS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

13 December 1976

The purpose of this survey is to gather information concerning revision and validation of CTS course materials, as well as alternate training material requirements, related to the Computerized Training System (CTS) in the 31E20, 31J20 and 35L20 courses.

Please answer all items in this survey with complete candor. Your responses will be held in strictest confidence. The results of this survey will enable the revision and validation of training materials to be more effective.

If you feel that you are not in a position to answer a particular question because you have not been closely associated with the CTS project, please circle the item number and leave it blank. Your comments or suggestions will be greatly appreciated.

Place a check (✓) mark by your location and position in your organization. You do not have to sign this form.

Location

Training Development Directorate (Staff)	____	Education Specialist	____
Department	____	Training Specialists	____
Training Design Division	____	Instructor	____
		Supv Training Instructor	____

PLEASE RECORD YOUR ANSWER OR CHECK (✓) THE ALTERNATIVE WHICH BEST EXPRESSES YOUR REACTION TO EACH ITEM THAT FOLLOWS.

REVISED AND ALTERNATE TRAINING MATERIALS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
SECTION I. Revision and Validation of Training Materials. 1. CTS provides more flexibility in revising instructional materials than does the self-paced system.						
2. Little difficult has been experienced in revising: a. Individual displays.						
b. Tests.						
c. Units of instruction.						
d. Flow of instruction						
3. The CTS review process has reduced the time normally required for introducing new or revised materials into the classroom.						
4. CTS instructional materials can be introduced into the course <u>without</u> the usual printing requirement procedures.						

REVISED AND ALTERNATE TRAINING MATERIALS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
5. It is easier to validate instructional materials on-line than it is to validate conventional or other self-paced printed materials.						
6. It takes less time to review CTS instructional materials on-line than it does to review self-paced training materials.						
7. Minor revisions to CTS instructional materials are accomplished during the on-line review process.						
8. Using students to validate CTS on-line training materials has been helpful in revising instructional units.						
9. The use of small and large student groups to validate revised CTS instructional units has not impaired the review process.						

REVISED AND ALTERNATE TRAINING MATERIALS SURVEY
COMPUTERIZED TRAINING SYSTEMS (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.

SECTION II. Back-up Training Materials.	Yes	No	Explanation
10. Was it necessary to prepare back-up training materials to be used exclusively to cover computer down time? If yes, please explain.			
11. Were course personnel, other than instructional programmers, used to prepare back-up training materials to cover computer down time? If yes, please explain.			
12. Did the requirement to develop back-up training materials increase the workload for the course writers? If yes, what percentage?			
13. Could CTS instructional materials, prepared for entry on-line, be used as back-up material for ininstruction during down time?			
14. Was it possible to use computer printouts of on-line instructional material as back-up training material during computer down time? Please explain.			

REVISED AND ALTERNATE TRAINING MATERIALS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

	Yes	No	Explanation
15. In determining course resource requirements, should additional personnel be programmed to handle the preparation of back-up materials? Please explain.			
16. Can CTS instructional materials plus back-up, be prepared with the same number of personnel required to prepare instructional materials for the conventional self-paced mode.			
17. Do you think there is a legitimate requirement to develop back-up instructional materials for all CTS on-line instruction? If yes, please explain.			
18. Do your students have a copy of the training objectives when they start training? If not, why?			
19. Do you pretest your revised training packages?			
20. Do you validate your units of instruction individually?			
21. Do you validate the annex or task in its entirety?			

REVISED AND ALTERNATE TRAINING MATERIALS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

	Yes	No	Explanation
22. Are statistical procedures used in validating your training packages? If not, explain how you validate.			
23. Do you think there is a legitimate requirement to develop back-up instructional materials for all CTS on-line instruction? If yes, please explain.			

SECTION III. General Summary.

24. After a task or annex has been revised by the instructional programmer how much time is normally required for review and approval before these materials can be used in the classroom?

a. 15 days _____

b. 30 days _____

c. 45 days _____

d. 60 days _____

e. Other _____

25. How much time has been saved as a result of implementation of CTS in the modification, revision and validation of course materials?

a. 0 days

b. 5 days

c. 10 days

d. 20 days

e. 30+ days

---

26. Have you encountered any special problems in preparing CTS instructional materials not noted when preparing prior self-paced materials?

27. How would you change the present system of revising lesson materials to insure adequate back-up for CTS on-line instruction?

28. What problems peculiar to CTS were encountered when using small and large student groups for validation of training materials?

AD-A060 466 HUMAN RESOURCES RESEARCH ORGANIZATION ALEXANDRIA VA F/G 5/9
EVALUATION OF A PROTOTYPE COMPUTERIZED TRAINING SYSTEM (CTS) IN--ETC(U)
AUG 78 R J SEIDEL, R ROSENBLATT, H WAGNER DAAB09-77-C-0010
UNCLASSIFIED HUMRRO-FR-ED-78-10 NL

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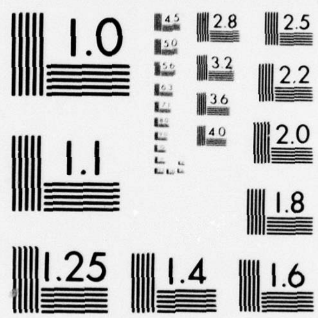
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Attachment 4

STRUCTURED INTERVIEW FORMAT

COURSE DEVELOPMENT SUMMARY SHEET

NAME: ____________________ POSITION: ____________________ DATE: ________

Course(s) worked on:

	Course	Annex(es)/Task(s)	Position	Time Period
1.				
2.				
3.				
4.				
5.				
6.				

NAME: ______________________

COURSE: ______________________________ TIME PERIOD: ____________

Estimated days worked in course: __________

Annex/task: ________________

TAISs in Annex: _______

TAISs worked on: ________

Estimated # days worked on annex: ________

		Off-line Presentation	On-line Presentation
a.	Pre- and Post-Tests	_____	_____
b.	EPIS Tests	_____	_____
c.	Performance Tests	_____	_____
d.	Practice Problems/Materials	_____	_____
e.	Performance Guides	_____	_____
f.	Lesson Materials such as special texts, or on-line presentations	_____	_____
g.	Remediation Activities	_____	_____
h.	A/V Materials	_____	_____
i.	Training Aids	_____	_____
j.	Directions	_____	_____
k.	Lesson Outlines	_____	_____
l.	Other ________________	_____	_____
		% of time: _____	% of time: _____

For ______________ Course, % thrown out due to POI changes.

NAME: ______________________

COURSE: ______________________ TIME PERIOD: ____________

Annex/Task: ______________________

	Off-line Presentation	On-line Presentation
a. Planning, Course Outlines, Strategies	____	____
b. Original Authoring (writing, typing, coding)	____	____
c. Converting Existing Materials	____	____
d. Modifying Materials due to POI Changes	____	____
e. Reviewing, Debugging, Testing, etc., Materials	____	____
f. Revising Materials	____	____
g. Coordination	____	____
h. Other ______________	____	____

NAME: ____________________ DATE OF INTERVIEW: __________

What feedback is available for you to use in revising instructional materials and tests (e.g., *Aug. PI by Task or TAIS*)?

How have you used it?

What additional feedback would you like to have?

How would you use it?

NAME ______________________________ COURSE ______________________________ Tel. No. _____

8.6.1 *What special qualifications are required by the instructional support staff?*

a. Instructional Programmers

b. Course Development Personnel

c. Computer Service Personnel

d. IPES

e. Other (specify)

NAME ______________________ COURSE ______________________ Tel. No.________

8.6.2 *What administrative and personnel costs were incurred to establish in-service training programs (for CTS Instructors and Workshops for Instructional Programmers and IPES personnel)?*

Recommended Data Source: *Input from ISASIG Data Systems Division*

Comments: *Additional interview and/or survey questions appear necessary.*

NAME ______________________ COURSE ______________________ Tel. No. __________

7.2.1 What difficulties have been encountered in fitting the previously developed self-paced instructional materials into the CTS instructional model?

NAME ______________________ COURSE ______________________ Tel. No. ________

7.2.3 *What special problems, if any, were encountered when entering (inputting) training materials on line?*

NAME ______________________________ COURSE ___________________________ Tel. No. __________

9.1 *What is the average training time by task and annex for each CTS course? What is the standard deviation? How many graduates were there in each course?*

NAME ______________________ COURSE ______________________ Tel. No. __________

9.2 *What was the number and percentage of students who failed to graduate from each CTS course?*

ATTACHMENT 5

CTS TIME LOG

COURSE/STAFF ELEMENTS PAGE:

NAME:

UNIT LABELS:

TASK	Time spent on task (Daily 1/4 hrs)						Remarks
	Mon	Tue	Wed	Thur	Fri	Total	
Preliminary Planning							
Unit Development							
Text (Displays)							
On-Line Graphics							
Off-Line Graphics							
Training Devices							
Off-Line Material							
Coding							
Audio							
ETV							
TEST							
Editing and Debugging							
Text (Displays)							
On-Line Graphics							
Off-Line Graphics							
Training Devices							
Off-Line Material							
Coding							
Audio							
ETV							
TEST							
Review and Revision							
Student Mode Review							
Peers and Supr							
Individual Student							
Revision							
Equipment Set-Up							
Total CRS DEV							

FCSIGS Form 68
1 Oct 74

OPERATIONAL REPORTS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

DATE_______________________

The purpose of this survey is to collect information on maintenance of student records in the courses utilizing computers. This information will be analyzed with the idea of making record keeping simpler and easier to maintain.

Please indicate your position below by a check mark (✓). If more than one position applies, make additional check marks.

_____ Dept Operations Chief

_____ Dept Education Specialist

_____ Dept Course Materials Analyst

_____ Dept Records Clerk

_____ Division Chief

_____ Division NCOIC

_____ Course Chief

_____ Course NCOIC

_____ Course Training Specialist

_____ Course Section Chief

_____ Course Instructor

The following is a glossary of terms which will assist you in answering the questions:

. On-line Testing - Using the computer to administer, score, and record a student's test.

. Diagnostic Tests (quizzes) - An informal test.

. Regularly - At regular times or intervals.

. Occasionally - Now and then.

. Seldom - On only a few occasions.

. On-line - Interaction of operating a terminal with the computer.

. Downtime - An interval of time when the computer is not productive.

OPERATIONAL REPORTS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
SECTION I. Weekly Student Activity Reports. 1. CTS has reduced the time the classroom instructor spends on student records.						
2. Weekly student activity printouts enable rapid analysis of student accomplishment in relation to his peers.						
3. The ability to display student records on the terminal a. provides effective real time feedback on student progress.						
b. saves time in assessment of student needs.						
4. CTS has had no impact on student record keeping at the division/ department level.						

OPERATIONAL REPORTS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
5. CTS has been successful in routing students into the learning alternative dictated by their prior accomplishments in the course.						
6. CTS reports enable course managers to a. assess trends as they develop						
b. update the instructional process with minimum delay.						
7. CTS student record printouts enable the instructor to a. analyze student progress						
b. provide individual assistance						
c. prescribe remedial training.						
8. Recording no-goes in the weekly report has assisted in managing the student through the course.						

9. The objective of the Weekly Student Activity Report is to provide the course manager with timely information concerning student progress and achievement.

   a. How well do you think the CTS Weekly Student Activity Report has met this objective?

   b. Has the expanded CTS Weekly Student Activity Report provided you with a better management tool? Explain.

   c. Is the revised CTS Student Graduation Report received in time to assist the course/division/department in completing the student records? Explain.

   d. Has CTS improved the timeliness of the Student Graduation Prediction? Explain.

   e. Should any additional items be included or deleted from the Weekly Student Activity Report? If yes, explain.

OPERATIONAL REPORTS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Plese check the appropriate block to indicate your opinion of the following statements. If more space is needed for your comments, please identify the item and use the space at the end of this section.	NEED				FORMAT			UTILI-ZATION			FUNCTION			ACCURACY			REVISION			Comment
	Essential	Non-essential	Continue	Discontinue	Excellent	Satisfactory	Needs Revision	Regularly	Occasionally	Seldom	Serves Intended Purpose	Of Marginal Use	Serves No Useful Purpose	Generally Accurate	Minor Discrepancies	Numerous Errors	Should Not Be Changed	Minor Revision Necessary	Major Revision Necessary	
SECTION II. CTS Operational Reports 1. Student Class Roster																				
2. Student Evaluation Roster																				
3. Weekly Student Activity Report																				
4. Graduation Prediction																				
5. Graduation Report																				
6. Course/Task Report (Monthly)																				
7. Course Absentee Report (Monthly)																				
8. Company Absentee Report (Monthly)																				

OPERATIONAL REPORTS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. If more space is needed for your comments, please identify the item and use the space at the end of this section.	NEED				FORMAT			UTILIZATION			FUNCTION			ACCURACY			REVISION			Comment
	Essential	Non-essential	Continue	Discontinue	Excellent	Satisfactory	Needs Revision	Regularly	Occasionally	Seldom	Serves Intended Purpose	Of Marginal Use	Serves No Useful Purpose	Generally Accurate	Minor Discrepancies	Numerous Errors	Should Not Be Changed	Minor Revision Necessary	Major Revision Necessary	
9. TAIS Report (Monthly)																				
10. Test Analysis (Monthly)																				
11. Question Analysis (Monthly) a. Distractor Count																				
b. Constructed Response Printout																				
12. Student Record Printout																				

ADDITIONAL COMMENTS:

13. Does the CTS system provide your course(s) with the necessary operational reports? If not, please list and describe any additional reports you think are necessary.

14. What CTS reports are not necessary? List and explain.

SECTION III. Student Record.

The student record file was created to provide real time access to individual student records, both on-line and printouts, as required by the primary instructor or course managers.

1. Does the student record contain the necessary information to enable you to

   a. analyze a student's progress? Explain.

   b. prescribe remedial training? Explain.

   c. take action to separate the student from the course? Explain.

2. Have you experienced any problems in using the terminal to call up a student's record? If yes, explain.

OPERATIONAL REPORTS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

3. When you call for a student's record on-line, is there any appreciable time lag in obtaining the display? If yes, explain.

4. Has the printout of the student's record been available on a timely basis? If no, explain.

5. Does the student record contain the necessary data to support the counselling and guidance program in your course? If no, explain.

6. Do you use the student record printout to support faculty board actions? Please explain.

7. What additional information do you need in the student record?

OPERATIONAL REPORTS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

SECTION IV. Computer Downtime and and Updating Student Activity Reports. (Answer the following questions with a "yes" or "no" and explain your answer.)

1. Does computer downtime interrupt the normal flow of CTS reports?

2. Did the computer downtime result in any of the following:

   a. Irretrievable loss of student data?

   b. Delay in student graduation?

   c. Distortion of students' progression index?

   d. Hand processing of student data?

   e. Overtime (extra) work for administrative personnel?

   f. Delay in training until the system was restarted?

   g. Explain any special problems not listed above.

3. Did the temporary delay of recurring reports adversely affect student training?

4. Do you consider computer downtime a major drawback to CTS?

5. Following computer downtime, was it necessary to manually record and input student data into the system to update any of the following reports:

a. Student Weekly Activity Report?

b. Graduation Prediction?

c. Graduation Report?

d. Course/Task Report?

e. Course Absentee Report?

f. Company Absentee Report?

g. Student Record (Data)?

h. Other (List)?

6. Reports listed below are automatically generated within the computer system. Have you experienced any problems with these reports because of loss of data during downtime?

   a. TAIS Report.

   b. Constructed Responses.

   c. Test Analysis.

   d. Question Analysis.

7. Were any particular problems, not discussed above, encountered in updating student activity reports following computer downtime?

8. Was it necessary to maintain a dual set of manually maintained student records to insure continuity during downtime?

9. Please list and explain any problems encountered with the CTS Operational Reports not previously covered.

STUDENT CLASS ROSTER

1. Are you familiar with this report? ____Yes ____No

(If No, turn page to next report.)

2. Is this report available to you?

a. _____ Regularly available
b. _____ Occasionally available
c. _____ Seldom or never available

3. How frequently do you use this report?

a. _____ Regularly
b. _____ Occasionally
c. _____ Seldom or never

4. How accurate is this report?

a. _____ Generally accurate
b. _____ Minor inaccuracies
c. _____ Numerous errors
d. _____ Cannot judge accuracy of report

5. What is your opinion about the format of this report?

a. _____ Excellent format
b. _____ Format is satisfactory
c. _____ Format requires revision
d. _____ No opinion

6. The information contained in this report is

a. _____ Essential
b. _____ Non-essential

7. The content of this report

a. _____ Should not be changed
b. _____ Needs minor revisions in the content
c. _____ Needs major revisions in the content

8. How useful do you find this report?

a. _____ Serves intended purpose
b. _____ Of marginal use
c. _____ Serves no useful purpose

COMMENTS: ____

____

____

____

STUDENT EVALUATION ROSTER

1. Are you familiar with this report? ____Yes ____No

   (If No, turn page to next report.)

2. Is this report available to you?

   a. _____ Regularly available
   b. _____ Occasionally available
   c. _____ Seldom or never available

3. How frequently do you use this report?

   a. _____ Regularly
   b. _____ Occasionally
   c. _____ Seldom or never

4. How accurate is this report?

   a. _____ Generally accurate
   b. _____ Minor inaccuracies
   c. _____ Numerous errors
   d. _____ Cannot judge accuracy of report

5. What is your opinion about the format of this report?

   a. _____ Excellent format
   b. _____ Format is satisfactory
   c. _____ Format requires revision
   d. _____ No opinion

6. The information contained in this report is

   a. _____ Essential
   b. _____ Non-essential

7. The content of this report

   a. _____ Should not be changed
   b. _____ Needs minor revisions in the content
   c. _____ Needs major revisions in the content

8. How useful do you find this report?

   a. _____ Serves intended purpose
   b. _____ Of marginal use
   c. _____ Serves no useful purpose

COMMENTS: ____

____

____

____

WEEKLY STUDENT ACTIVITY REPORT

1. Are you familiar with this report? ____Yes ____No

   (If No, turn page to next report.)

2. Is this report available to you?

   a. _____ Regularly available
   b. _____ Occasionally available
   c. _____ Seldom or never available

3. How frequently do you use this report?

   a. _____ Regularly
   b. _____ Occasionally
   c. _____ Seldom or never

4. How accurate is this report?

   a. _____ Generally accurate
   b. _____ Minor inaccuracies
   c. _____ Numerous errors
   d. _____ Cannot judge accuracy of report

5. What is your opinion about the <u>format</u> of this report?

   a. _____ Excellent format
   b. _____ Format is satisfactory
   c. _____ Format requires revision
   d. _____ No opinion

6. The information contained in this report is

   a. _____ Essential
   b. _____ Non-essential

7. The <u>content</u> of this report

   a. _____ Should <u>not</u> be changed
   b. _____ Needs minor revisions in the content
   c. _____ Needs major revisions in the content

8. How useful do you find this report?

   a. _____ Serves intended purpose
   b. _____ Of marginal use
   c. _____ Serves no useful purpose

COMMENTS: ____

____

____

____

GRADUATION PREDICTION

1. Are you familiar with this report? ____Yes ____No

   (If No, turn page to next report.)

2. Is this report available to you?

   a. _____ Regularly available
   b. _____ Occasionally available
   c. _____ Seldom or never available

3. How frequently do you use this report?

   a. _____ Regularly
   b. _____ Occasionally
   c. _____ Seldom or never

4. How accurate is this report?

   a. _____ Generally accurate
   b. _____ Minor inaccuracies
   c. _____ Numerous errors
   d. _____ Cannot judge accuracy of report

5. What is your opinion about the <u>format</u> of this report?

   a. _____ Excellent format
   b. _____ Format is satisfactory
   c. _____ Format requires revision
   d. _____ No opinion

6. The information contained in this report is

   a. _____ Essential
   b. _____ Non-essential

7. The <u>content</u> of this report

   a. _____ Should <u>not</u> be changed
   b. _____ Needs minor revisions in the content
   c. _____ Needs major revisions in the content

8. How useful do you find this report?

   a. _____ Serves intended purpose
   b. _____ Of marginal use
   c. _____ Serves no useful purpose

COMMENTS: ____

GRADUATION REPORT

1. Are you familiar with this report? ____Yes ____No

   (If No, turn page to next report.)

2. Is this report available to you?

   a. _____ Regularly available
   b. _____ Occasionally available
   c. _____ Seldom or never available

3. How frequently do you use this report?

   a. _____ Regularly
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   a. _____ Excellent format
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   c. _____ Format requires revision
   d. _____ No opinion

6. The information contained in this report is

   a. _____ Essential
   b. _____ Non-essential

7. The content of this report

   a. _____ Should not be changed
   b. _____ Needs minor revisions in the content
   c. _____ Needs major revisions in the content

8. How useful do you find this report?

   a. _____ Serves intended purpose
   b. _____ Of marginal use
   c. _____ Serves no useful purpose

COMMENTS: ____

____

____

____

COURSE/TASK REPORT (MONTHLY)

1. Are you familiar with this report? ____Yes ____No

(If No, turn page to next report.)

2. Is this report available to you?

a. _____ Regularly available
b. _____ Occasionally available
c. _____ Seldom or never available

3. How frequently do you use this report?

a. _____ Regularly
b. _____ Occasionally
c. _____ Seldom or never

4. How accurate is this report?

a. _____ Generally accurate
b. _____ Minor inaccuracies
c. _____ Numerous errors
d. _____ Cannot judge accuracy of report

5. *What is your opinion about the format of this report?*

a. _____ Excellent format
b. _____ Format is satisfactory
c. _____ Format requires revision
d. _____ No opinion

6. The information contained in this report is

a. _____ Essential
b. _____ Non-essential

7. The content of this report

a. _____ Should not be changed
b. _____ Needs minor revisions in the content
c. _____ Needs major revisions in the content

8. How useful do you find this report?

a. _____ Serves intended purpose
b. _____ Of marginal use
c. _____ Serves no useful purpose

COMMENTS: ____

____

____

____

COURSE ABSENTEE REPORT (MONTHLY)

1. Are you familiar with this report? ____Yes ____No

(If No, turn page to next report.)

2. Is this report available to you?

a. _____ Regularly available
b. _____ Occasionally available
c. _____ Seldom or never available

3. How frequently do you use this report?

a. _____ Regularly
b. _____ Occasionally
c. _____ Seldom or never

4. How accurate is this report?

a. _____ Generally accurate
b. _____ Minor inaccuracies
c. _____ Numerous errors
d. _____ Cannot judge accuracy of report

5. What is your opinion about the <u>format</u> of this report?

a. _____ Excellent format
b. _____ Format is satisfactory
c. _____ Format requires revision
d. _____ No opinion

6. The information contained in this report is

a. _____ Essential
b. _____ Non-essential

7. The <u>content</u> of this report

a. _____ Should <u>not</u> be changed
b. _____ Needs minor revisions in the content
c. _____ Needs major revisions in the content

8. How useful do you find this report?

a. _____ Serves intended purpose
b. _____ Of marginal use
c. _____ Serves no useful purpose

COMMENTS: ____

____

____

____

COMPANY ABSENTEE REPORT (MONTHLY)

1. Are you familiar with this report? ____Yes ____No

(If No, turn page to next report.)

2. Is this report available to you?

a. _____ Regularly available
b. _____ Occasionally available
c. _____ Seldom or never available

3. How frequently do you use this report?

a. _____ Regularly
b. _____ Occasionally
c. _____ Seldom or never

4. How accurate is this report?

a. _____ Generally accurate
b. _____ Minor inaccuracies
c. _____ Numerous errors
d. _____ Cannot judge accuracy of report

5. What is your opinion about the format of this report?

a. _____ Excellent format
b. _____ Format is satisfactory
c. _____ Format requires revision
d. _____ No opinion

6. The information contained in this report is

a. _____ Essential
b. _____ Non-essential

7. The content of this report

a. _____ Should not be changed
b. _____ Needs minor revisions in the content
c. _____ Needs major revisions in the content

8. How useful do you find this report?

a. _____ Serves intended purpose
b. _____ Of marginal use
c. _____ Serves no useful purpose

COMMENTS: ____

TAIS REPORT (MONTHLY)

1. Are you familiar with this report? ____Yes ____No

(If No, turn page to next report.)

2. Is this report available to you?

a. _____ Regularly available
b. _____ Occasionally available
c. _____ Seldom or never available

3. How frequently do you use this report?

a. _____ Regularly
b. _____ Occasionally
c. _____ Seldom or never

4. How accurate is this report?

a. _____ Generally accurate
b. _____ Minor inaccuracies
c. _____ Numerous errors
d. _____ Cannot judge accuracy of report

5. What is your opinion about the <u>format</u> of this report?

a. _____ Excellent format
b. _____ Format is satisfactory
c. _____ Format requires revision
d. _____ No opinion

6. The information contained in this report is

a. _____ Essential
b. _____ Non-essential

7. The <u>content</u> of this report

a. _____ Should <u>not</u> be changed
b. _____ Needs minor revisions in the content
c. _____ Needs major revisions in the content

8. How useful do you find this report?

a. _____ Serves intended purpose
b. _____ Of marginal use
c. _____ Serves no useful purpose

COMMENTS: ____

____

____

____

TEST ANALYSIS (MONTHLY)

1. Are you familiar with this report? ____Yes ____No

   (If No, turn page to next report.)

2. Is this report available to you?

   a. _____ Regularly available
   b. _____ Occasionally available
   c. _____ Seldom or never available

3. How frequently do you use this report?

   a. _____ Regularly
   b. _____ Occasionally
   c. _____ Seldom or never

4. How accurate is this report?

   a. _____ Generally accurate
   b. _____ Minor inaccuracies
   c. _____ Numerous errors
   d. _____ Cannot judge accuracy of report

5. What is your opinion about the <u>format</u> of this report?

   a. _____ Excellent format
   b. _____ Format is satisfactory
   c. _____ Format requires revision
   d. _____ No opinion

6. The information contained in this report is

   a. _____ Essential
   b. _____ Non-essential

7. The <u>content</u> of this report

   a. _____ Should <u>not</u> be changed
   b. _____ Needs minor revisions in the content
   c. _____ Needs major revisions in the content

8. How useful do you find this report?

   a. _____ Serves intended purpose
   b. _____ Of marginal use
   c. _____ Serves no useful purpose

COMMENTS: ____

____

____

____

QUESTION ANALYSIS (MONTHLY)
Distractor Count

1. Are you familiar with this report? ____Yes ____No

(If No, turn page to next report.)

2. Is this report available to you?

a. _____ Regularly available
b. _____ Occasionally available
c. _____ Seldom or never available

3. How frequently do you use this report?

a. _____ Regularly
b. _____ Occasionally
c. _____ Seldom or never

4. How accurate is this report?

a. _____ Generally accurate
b. _____ Minor inaccuracies
c. _____ Numerous errors
d. _____ Cannot judge accuracy of report

5. What is your opinion about the format of this report?

a. _____ Excellent format
b. _____ Format is satisfactory
c. _____ Format requires revision
d. _____ No opinion

6. The information contained in this report is

a. _____ Essential
b. _____ Non-essential

7. The content of this report

a. _____ Should not be changed
b. _____ Needs minor revisions in the content
c. _____ Needs major revisions in the content

8. How useful do you find this report?

a. _____ Serves intended purpose
b. _____ Of marginal use
c. _____ Serves no useful purpose

COMMENTS: ______________________________

QUESTION ANALYSIS (MONTHLY)
Constructed Response Printout

1. Are you familiar with this report? ____Yes ____No

(If No, turn page to next report.)

2. Is this report available to you?

a. _____ Regularly available
b. _____ Occasionally available
c. _____ Seldom or never available

3. How frequently do you use this report?

a. _____ Regularly
b. _____ Occasionally
c. _____ Seldom or never

4. How accurate is this report?

a. _____ Generally accurate
b. _____ Minor inaccuracies
c. _____ Numerous errors
d. _____ Cannot judge accuracy of report

5. What is your opinion about the format of this report?

a. _____ Excellent format
b. _____ Format is satisfactory
c. _____ Format requires revision
d. _____ No opinion

6. The information contained in this report is

a. _____ Essential
b. _____ Non-essential

7. The content of this report

a. _____ Should not be changed
b. _____ Needs minor revisions in the content
c. _____ Needs major revisions in the content

8. How useful do you find this report?

a. _____ Serves intended purpose
b. _____ Of marginal use
c. _____ Serves no useful purpose

COMMENTS: ____

____

____

____

STUDENT RECORD PRINTOUT

1. Are you familiar with this report? ____Yes ____No

   (If No, turn page to next report.)

2. Is this report available to you?

   a. ______ Regularly available
   b. ______ Occasionally available
   c. ______ Seldom or never available

3. How frequently do you use this report?

   a. ______ Regularly
   b. ______ Occasionally
   c. ______ Seldom or never

4. How accurate is this report?

   a. ______ Generally accurate
   b. ______ Minor inaccuracies
   c. ______ Numerous errors
   d. ______ Cannot judge accuracy of report

5. What is your opinion about the <u>format</u> of this report?

   a. ______ Excellent format
   b. ______ Format is satisfactory
   c. ______ Format requires revision
   d. ______ No opinion

6. The information contained in this report is

   a. ______ Essential
   b. ______ Non-essential

7. The <u>content</u> of this report

   a. ______ Should <u>not</u> be changed
   b. ______ Needs minor revisions in the content
   c. ______ Needs major revisions in the content

8. How useful do you find this report?

   a. ______ Serves intended purpose
   b. ______ Of marginal use
   c. ______ Serves no useful purpose

COMMENTS: ____

____

____

____

ATTACHMENT #7

RESOURCE ALLOCATION SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

DATE____________________

The purpose of this survey is to collect information on the allocation of resources within your area. The results of this will be consolidated with other surveys to determine the effectiveness of the computerized training system.

As you read the statements and questions, make a mental comparison of your training area prior to and after the implementation of the computerized training system.

Please place a check (✓) mark by your location and position below. You do not have to sign the form.

Location

_____ Department (Opns)

_____ Division

_____ Course

_____ Section

Position

_____ Chief

_____ NCOIC

_____ Education Specialist

_____ Training Specialist

_____ Instructor

_____ Records Clerk

_____ Other

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RESOURCE ALLOCATION SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
1. The computer system has been able to accurately account for the location of each student within the course.						
2. The computer system has maintained an accurate accounting of student position vacancies.						
3. When the student completes a task, the system routes him to the next task without delay.						
4. Students are routed through the course according to the predetermined (normal) flow.						
5. Student routing has been accomplished with a minimum of errors.						
6. When <u>student positions</u> in the next sequential task are filled, the student is routed to an alternate task, for which he has the necessary prerequisites.						
7. When the student completes a task and all student positions in the succeeding tasks are filled, the instructor is alerted via the hard copy terminal.						

RESOURCE ALLOCATION SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
8. Routing students to the correct student positions has required close monitoring by the instructor/ supervisor.						
9. The instructor is alerted via the hard copy terminal when the student has completed all the required tasks.						

10. Prior to CTS, did accounting for student time in the course place an unnecessary burden on the classroom instructor? Yes_____ No _____ Explain.

11. Does the usefulness derived from using the computer for accounting for students time in the CTS tasks outweigh the workload inherent in its collection? Yes_____ No_______ Explain.

12. Has the computer system been effective in accounting for student time in the course below the task level? Yes ______ No ______ Explain.

13. What problems, if any, were encountered when a student was routed to an alternate task out of the normal sequence?

14. Has the computer system been effective in directing student progress through the course via the several learning alternatives (modes, progression levels)? Yes ______ No ______ Explain.

15. Do you think it is necessary to know the learning alternative in which each student is working? Yes ______ No ______ Explain.

RESOURCE ALLOCATION SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

16. Have you had any problems in determining the learning alternative in which the student is working? Yes _____ No _____ Explain.

17. What is your frank opinion of the capability of the computer system to route and account for students within your course? (Please indicate advantages and disadvantages)

Advantages	Disadvantages

ATTACHMENT #8

INSTRUCTIONAL PROCESS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Date________________

The purpose of this survey is to gather information concerning the comterized instructional process. Please answer each item in this survey with complete candor. Your responses will be held in strictest confidence. If you feel that you are not in a position to answer a particular question because you have not been closely associated with the CTS project, please circle the item number and leave it blank. Your comments or suggestions will be greatly appreciated.

Place a check (✓) mark by your position in your organization. You do not have to sign this form.

POSITION

DIVISION CHIEF _____

SUPERVISOR TRAINING INSTRUCTOR _____

INSTRUCTOR _____

PLEASE RECORD YOUR ANSWER OR CHECK (✓) THE ALTERNATIVE WHICH BEST EXPRESSES YOUR REACTION TO EACH ITEM THAT FOLLOWS.

INSTRUCTIONAL PROCESS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
SECTION I. Optimum Student Position/ Terminal Relationship. 1. Each student carrel (bench position) should be equipped with a computer terminal.						
2. One computer terminal programmed for every four students has proved to be a very satisfactory ratio.						
3. If each student carrel (bench position) had a computer terminal, the utilization would not be great enough to make it cost effective.						
4. Student queuing at the computer terminals has not been a problem.						
5. With approximately 12% of the course material in the CAI mode, the students have had no difficulty in using the computer terminal whenever necessary.						
6. If the percentage of CAI is increased, it will be necessary to reduce the present 4 to 1 student to terminal ratio in the courses.						

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INSTRUCTIONAL PROCESS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
7. Student to terminal ratio cannot be fixed at other than one-to-one when operating primarily in the CAI mode.						
8. Computer terminals should be installed in the classrooms that contain student carrels (bench positions), not in separate classrooms.						
9. The only mode that allows fixing an optional student to terminal ratio is the CAI mode.						
10. The terminal use time required by each student to complete a specific unit will vary because of self-pacing.						
11. To prevent queuing problems, <u>when all student terminals are in use,</u> a provision should be made for the student in the CMI mode to obtain his next off-line assignment via the instructor's (proctor) terminal.						
12. Despite the erratic student flow, which is normal for self-pacing, one computer terminal can adequately handle four students.						

INSTRUCTIONAL PROCESS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
13. Since many units of instruction have no CAI, the computer terminals have been idle a large portion of the time although the normal student to terminal ratio is 4 to 1.						
14. Clustering all the course computer terminals in classrooms isolated from student carrels (bench positions) has enabled maximum utilization of the terminals.						
15. Optimum student position/terminal relationship can only be defined when the percentage of CAI in the course remains constant.						
16. When the computer is used for both instruction and student management, no valid conclusions can be drawn with regard to the optimum student position/terminal ratio.						
17. A terminal at each student carrel (bench position) would maximize student interactive and student managed instruction.						

INSTRUCTIONAL PROCESS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

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18. Based on student utilization, the optimum student position to computer terminal ratio should be:

    a. 1 to 1 ______

    b. 2 to 1 ______

    c. 3 to 1 ______

    d. 4 to 1 ______

    e. 5 to 1 ______

    f. Other ______

19. Students would experience no queuing problems if the student to terminal ratio did not exceed:

    a. 2 to 1 ______

    b. 3 to 1 ______

    c. 4 to 1 ______

    d. 5 to 1 ______

    f. Other ______

20. An equipment laboratory containing 12 student carrels (bench positions) should have a minimum of

    a. 2 terminals ______

    b. 4 terminals ______

    c. 6 terminals ______

    d. 12 terminals ______

    e. Other ____________ terminals

INSTRUCTIONAL PROCESS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

Please check the appropriate block to indicate your opinion of the following statements. Comments explaining your selection will be appreciated.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
SECTION II. Interface Between Student and Instructor. Note: A major problem area of self-paced instruction has been the limited time the classroom instructor is available to assist each individual student. 21. Since the implementation of CTS the classroom instructor has had more time to interact directly with the student.						
22. CTS has relieved the classroom instructor of many of his record keeping requirements.						
23. There has been no discernible change in the availability of the classroom instructor to interact with the student as the result of CTS.						
24. The ability of the computer to manage the students' off-line activities has reduced the time the instructor must spend on administrative actions.						
25. Freeing the instructor of administrative duties is one of the most favorable aspects of CTS.						

INSTRUCTIONAL PROCESS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

SECTION III. CTS Back-up Capability.

26. Are adequate instructional materials available to conduct instruction during computer down time? Yes ______ No ______ If no, please explain.

27. Is the students' progress impeded because of the quality of CTS back-up instructional materials? Yes ______ No ______ If yes, please explain.

28. Have you been able to use printouts of on-line instructional materials as back-up instructional aids during computer down time?
Yes ______ No ______ If no, please explain.

29. Are printouts of on-line instructional materials available in sufficient quantities to meet student needs? Yes ______ No ______ If no, how can this be improved?

30. Do the classroom instructors rely on printouts of on-line materials for back-up instruction when the computer is down? Yes ______ No ______ If no, please explain.

31. Is it necessary to revert to instructional materials used prior to the implementation of CTS for back-up during computer down time? Yes _____ No _____ If yes, please explain.

32. Has computer down time been more or less of a problem than failure of other AV devices (eg., TV, sound/slides)? Please explain.

INSTRUCTIONAL PROCESS SURVEY
COMPUTERIZED TRAINING SYSTEM (CTS)

SECTION IV. Changes that Impact on Student Motivation.

33. Since the implementation of CTS, have any changes that would impact on student motivation been made in the following areas?

	Yes	No	Explain
a. Promotion (student) policies			
b. Leave policy			
c. Assignment policy			
d. Award of MOS			
e. Major course revision			
f. Changes in shifts (day to night)			

34. Can you identify any policy changes or other actions, not cited above, that may have affected student motivation (favorably or adversely) during the CTS field test?

Attachment #9

STUDENT ATTITUDE QUESTIONNAIRE

COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

POST COURSE DATA
(In Percentages)

This is a questionnaire to gather information relative to computerized training system (CTS) courses of instruction. There are no right or wrong answers. Rather, we are interested in your candid opinion of the following statements. Your complete frankness in recording your opinions will be greatly appreciated. Individual responses will be held in strictest confidence.

PLEASE RECORD YOUR ANSWER OR CHECK (✓) THE ALTERNATIVE WHICH BEST EXPRESSES YOUR REACTION TO EACH ITEM THAT FOLLOWS.

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

Please check the appropriate block to indicate your opinion of the following statements. Explain your selection in the comments, if necessary.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
SECTION I. Course Content and Instructional Media.					
1. The objectives of the course are clear and I know what is expected of me.	17.65	38.24	17.65	17.65	8.82
2. The material in each unit is organized in a way that I can learn.	8.82	23.53	41.18	14.71	11.76
3. The overall course content holds my interest.	17.65	32.35	32.35	8.82	8.82
4. The lesson material makes you think.	20.59	52.84	23.53	0.00	2.94
5. I cannot learn what I want to learn with this kind of instruction.	8.82	32.35	35.29	11.76	11.76
6. Generally, the lessons are hard to understand.	11.76	38.24	29.41	14.71	5.88
7. Generally, the lessons are too long.	11.76	26.47	35.29	20.59	5.88
8. The level of reading skill required in most lessons is too high.	32.35	32.35	26.47	5.88	2.94

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

Please check the appropriate block to indicate your opinion of the following statements. Explain your selection in the comments, if necessary.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
9. Performance examinations cover what is presented in the lessons.	14.71	32.35	26.47	17.65	8.82
10. Generally, the lessons seem to be planned just for me.	8.82	11.76	38.24	26.47	14.71
11. I learn the course material very quickly using this method of instruction.	8.82	14.71	44.12	23.53	8.82
12. I find myself hurrying through a lesson to get it over with rather than trying to learn.	23.53	41.18	20.59	11.76	2.94
13. I answer questions wrong intentionally (pretest, posttest) in order to get more instruction.	41.18	38.24	17.65	2.94	0.00
14. I waste no time when using this method of instruction.	2.94	20.59	32.35	29.41	14.71
15. I do my best as a result of this method of instruction.	20.59	20.59	26.47	23.53	8.82
16. I always know how well I am doing in this course.	5.88	29.41	41.18	8.82	14.71
17. CTS is a very effective method of instruction.	8.82	17.65	32.35	26.47	14.71

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

Please check the appropriate block to indicate your opinion of the following statements. Explain your selection in the comments, if necessary.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
18. I feel that no one really cares whether I learn or not using this method of instruction.	14.71	35.29	35.29	14.71	0.00
19. I feel that I am pushed too rapidly through the lesson material.	23.53	44.12	20.59	8.82	2.94
20. An instructor is readily available for assistance.	2.94	20.59	23.53	32.35	20.59
21. The instructors can answer my questions.	20.59	44.12	26.47	5.88	2.94
22. There is a good working relationship between the instructors and myself.	20.59	29.41	41.18	5.88	2.94
23. Background noise (voices, movement, operation of equipment) is distracting.	14.71	29.41	38.24	8.82	8.82
24. Working in the carrels and other student positions becomes tiresome over a long period of time.	14.71	11.76	26.47	35.29	11.76
25. There are so many devices (computer terminals, TV/cassettes, slide projectors) to operate that it distracts from the instruction.	17.65	38.24	26.47	11.76	5.88

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

Please check the appropriate block to indicate your opinion of the following statements. Explain your selection in the comments, if necessary.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
26. Constant changes from one instructional media to another interfers with learning.	11.76	38.24	32.35	8.82	8.82
27. CAI (student interacts with computer terminal) provides a better learning environment than other methods.	5.88	14.71	38.24	29.41	11.76
28. The computer terminal is easy to operate.	32.35	50.00	14.71	2.94	0.00
29. The computer terminal text displays are clear and easy to read.	32.35	38.24	23.53	0.00	5.88
30. The amount of material presented on the individual terminal displays is <u>not</u> excessive.	14.71	41.18	35.29	8.82	0.00
31. The sequencing of the computerized lesson material (each lesson builds on preceding lesson) makes learning relatively easy.	11.76	29.41	41.18	8.82	8.82
32. The amount of CAI (student interacts with computer terminal) in the course, compared to other methods, is highly satisfactory.	8.82	17.65	52.94	14.71	5.88

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

Please check the appropriate block to indicate your opinion of the following statements. Explain your selection in the comments, if necessary.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
33. The computer terminals are inoperative too often, which wastes my time.	8.82	11.76	38.24	23.53	17.65
34. If I had my choice, I would prefer CAI over other methods.	8.82	14.71	29.41	29.41	17.65
35. Graphic displays on the computer terminal were sharp and easy to understand.	14.71	35.29	41.18	2.94	5.88
36. I had no problem in learning to use the keyboard at the computer terminal.	35.29	44.12	11.76	2.94	5.88
37. I feel that computerized instruction challenged me to do my very best.	26.47	20.59	35.29	8.82	8.82
38. If I have the opportunity to take another Army training course, I would prefer CTS as the method of instruction.	8.82	26.47	17.65	23.53	23.53
SECTION II. CMI Mode (Material presented off-line under computer management).					
39. Most of my time in the course is spent in the CMI mode.	0.00	38.24	38.24	14.71	8.82

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

Please check the appropriate block to indicate your opinion of the following statements. Explain your selection in the comments, if necessary.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
40. I prefer receiving all my assignments via the computer terminal.	5.88	29.41	32.35	23.53	8.82
41. I feel that receiving my assignments via the computer terminal has enabled me to lower my progression index (P.I.)	8.82	26.47	32.35	14.71	17.65
42. The instructors kept referring me to the computer terminal for directions rather than answering my questions about off-line assignments.	8.82	32.35	32.35	23.53	2.94
43. I had no difficulty in getting to use a computer terminal whenever it was necessary.	5.88	17.65	35.29	23.53	17.65
44. I feel that the CTS instruction is too impersonal with so much time spent in the CMI mode.	5.88	17.65	44.12	29.41	2.94
45. Computer down time did <u>not</u> affect my progress through the course.	0.00	14.71	23.53	35.29	26.47
46. It was difficult for me to determine my next training task when the computer system was down.	14.71	23.53	35.29	20.59	5.88
47. You always know exactly where you stand in the course when in the CMI mode.	8.82	20.59	41.18	11.76	17.65

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

Please check the appropriate block to indicate your opinion of the following statements. Explain your selection in the comments, if necessary.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
48. I like the feeling of independence associated with computer managed instruction.	14.71	29.41	41.18	11.76	2.94
49. I would rather receive my off-line assignments from an instructor so I can ask questions and clarify any points that I don't understand.	5.88	20.59	38.24	14.71	20.59
50. I would like to have more instruction in the CAI mode.	5.88	23.53	47.06	14.71	8.82
51. I would rather go through the course at the same speed as the other students as I seem to learn more in a group.	17.65	29.41	32.35	11.76	8.82
52. It is easier to connect learning elements in the CMI mode than it is under other types of instruction I have experienced.	5.86	23.53	50.00	8.82	11.76
53. I have experienced no problems in moving through the course in either the CAI or CMI mode.	11.76	20.59	41.18	14.71	11.76
54. Instructions received via the computer terminal are clear, concise and easy to follow.	11.76	44.12	35.29	5.88	2.94

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

Please check the appropriate block to indicate your opinion of the following statements. Explain your selection in the comments, if necessary.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
55. I feel that my progression index (P.I.) would be lower if my course activities were controlled by the classroom instructor.	11.76	11.76	41.18	26.47	8.82
56. Not being able to ask the instructor a question immediately when a problem occurred has made learning more difficult for me.	5.88	14.71	44.12	20.59	14.71
57. There were not enough computer terminals in the course to meet all the student requirements.	20.59	35.29	29.41	5.88	8.82
58. Too much waiting occurred because the computer terminals were down for maintenance.	14.71	29.41	41.18	5.88	8.82
59. Waiting to get to a computer terminal caused me to lose time in getting through the course.	14.71	26.47	38.24	14.71	5.88
60. I would prefer to have a computer terminal at each classroom position.	23.53	32.35	29.41	8.82	5.88
61. In my course there were too many students for the number of computer terminals available.	5.88	5.88	26.47	35.29	26.47
62. The best configuration for CTS is to cluster the computer terminals in one classroom.	2.94	5.88	38.24	29.41	23.53

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

SECTION III. On-Line Time per Session.

63. Did you have any experience working with computer terminals in a classroom prior to taking this course?

Yes 23.53 No 76.47

64. Did you complete a lesson unit of 2 hours or more using a computer terminal as the instructional medium prior to this course?

Yes 29.41 No 70.59

65. Did you receive any instruction on the operation of computer terminals prior to entering this course?

Yes 38.24 No 61.76

66. Did you have any difficulty in learning to operate the computer terminal?

Yes 11.76 No 88.24

67. How long did it take you to learn to operate the computer terminal in this course?

a. 70.59 15 min.

b. 17.65 30 min.

c. 2.94 45 min.

d. 5.88 60 min.

e. 2.94 Other (show time)

68. What was the average time you spent interacting with the computer terminal during a single session in the CAI mode?

a. 2.94 10 min.

b. 23.53 20 min.

c. 35.29 30 min.

d. 14.71 40 min.

e. 8.82 50 min.

f. 14.71 Other (show time)

69. At what point in time did you begin to feel uncomfortable working at the computer terminal without a break?

a. Ø.ØØ After 10 minutes

b. 23.53 After 20 minutes

c. 29.41 After 30 minutes

d. 8.82 After 40 minutes

e. 14.71 After 50 minutes

f. 23.53 Other (show time)

70. What is the maximum period (except for normal breaks) you spent in direct contact with the terminal during any one training day that you worked with the computer?

a. 32.35 1 hour

b. 26.47 2 hours

c. 26.47 3 hours

d. 8.82 4 hours

e. 5.88 Other (show time)

71. Based on your experience, what is the maximum time a student should spend at the computer terminal without a break?

a. 26.47 30 minutes

b. 38.24 45 minutes

c. 29.41 60 minutes

d. 5.88 75 minutes

e. Ø.ØØ Other (show time)

72. If you could establish the time-length per session, how much time would you schedule a student to spend at the computer terminal?

a. Without a break -

(1) 5.88 10 minutes

(2) 17.65 20 minutes

(3) 23.53 30 minutes

(4) 23.53 40 minutes

(5) 23.53 50 minutes

(6) 5.88 Other (show time)

b. With a 10 minute break between sessions -

(1) 17.65 30 minutes

(2) 47.06 1 hour

(3) 26.47 1½ hours

(4) 5.88 2 hours

(5) 0.00 3 hours

(6) 2.94 Other (show time)

73. In your opinion, the ideal time length for interaction with the computer terminal would be how many minutes out of each 50 minute period?

a. 11.76 10 minutes

b. 35.29 15 minutes

c. 8.82 20 minutes

d. 14.71 25 minutes

e. 11.76 30 minutes

f. 17.65 Other

74. In your opinion, the ideal time-length for interaction with the computer terminal should not exceed how many hours in any one day?

a. 8.82 1 hour

b. 26.47 2 hours

c. 41.18 3 hours

d. 17.65 4 hours

e. 5.88 Other

SECTION IV. Acceptance of Compute ed Instruction

75. What do you like best about computerized instruction (rank in order of preference)?

a. 24.71 I can go at my own speed.

b. 20.59 It presents materials in a clear and interesting way.

c. 18.82 I am always being asked questions.

d. 18.24 I like the freedom offered by CTS.

e. 17.65 I am not bothered by an instructor except when I need him.

f. 0.00 Other (specify) ____________________

76. What do you like least about computerized instruction (rank in order of preference)?

a. 22.35 I cannot ask questions.

b. 18.24 It is too much work.

c. 19.41 I have to learn to operate too much instructional equipment.

d. 18.82 It is too impersonal.

e. 21.18 It leaves out too much information that an instructor would provide.

g. 0.00 Other (specify) ____________________

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

77. Which lessons or part of the course caused you the most difficulty? (Be as specific as possible.)

78. Which instructional devices and classroom (working) conditions cause the most annoyance? (Be as specific as possible.)

a. Instructional devices -

b. Classroom (working) conditions -

79. What is your frank opinion concerning the relative worth of computerized instruction versus other methods of instruction with which you are familiar? (Please identify other methods of instruction.)

NOTE: Please conplete the items on the last page, detach and return to the instructor.

STUDENT ATTITUDE QUESTIONNAIRE
COMPUTERIZED TRAINING SYSTEM (CTS) INSTRUCTION

- DETACH -

Background Information

To insure that all students complete the questionnaire, you are asked to answer the following items, detach from the questionnaire, and return to the instructor.

DATE: ____________________

NAME: ____________________

COURSE: ____________________

Check the approximate time you have been in this course:

a. Three weeks ________.

b. Completed the entire course ________.

- DETACH -

ATTACHMENT #10

MEMORANDUM OF UNDERSTANDING

BETWEEN

Product Manager Computerized Training System Fort Monmouth, New Jersey	Commandant US Army Signal School Fort Gordon, Georgia

1. INTRODUCTION:

a. References:

(1) USASESS Reg 10-2, subject: Organization, Mission and Functions, dated July 1973.

(2) Prototype Computerized Training System Management Plan (as revised 13 Nov 73).

(3) Product Manager Charter, Prototype Computerized Training System (as revised 5 Nov 73).

(4) Letter, ATSN-CTS, USASCS, 29 Nov 73, subject: Designation of Courses for Prototype Computerized Training System (CTS), with 1st Ind, ATTS-ITR, TRADOC, 11 Dec 73.

b. In accordance with cited references, this Memorandum of Understanding delineates responsibilities, command and control channels, and procedures to be followed in the operational test and evaluation of a Prototype Computerized Training System (Project ABACUS) by the Office of the Product Manager, Fort Monmouth, and the US Army Signal School (USASIGS), Fort Gordon, Georgia.

2. GENERAL RESPONSIBILITIES:

a. The Commandant, USASIGS, reference 1a (1), is responsible for preparing, conducting and administering course of instruction/programs of instruction (POI).

b. The Commandant, USASIGS, reference 1a (2), is responsible for monitoring and supporting the three courses reference 1a (4) involved in the operational phase of Project ABACUS for the Product Manager.

c. The Product Manager, CTS, reference la (3), is responsible for the design, hardware/software development, course development, operation, and evaluation of Project ABACUS. In this capacity the Product Manager, CTS, will advise the Commandant, USASIGS, during the operational test period in those areas of responsibility as they apply to the operational test and evaluation.

3. DETAILED RESPONSIBILITIES:

a. The Product Manager, CTS, will:

(1) Procure, deliver, install and conduct the acceptance test of the hardware/software system for operation at USASIGS, Fort Gordon.

(2) Provide necessary interfacing between USASIGS and other activities, elements, and contractors in matters pertaining to the prototype operational test and evaluation.

(3) Develop the evaluation plan; designate data to be recorded and required format; collect and analyze test data and prepare the formative, interim, and final evaluation reports.

(4) Prepare appropriate program and planning documents as required by and for submission to higher headquarters. Documents applicable to the operational test and evaluation will be coordinated with the Commandant, USASIGS. The final document shall include Commandant, USASIGS concurrence/comments.

(5) Establish and provide to the Commandant, USASIGS, operational test facilities requirements.

(6) Provide a training program for USASIGS system and course personnel in the system, the instructional model, and course development techniques.

(7) Establish and maintain a field office at USASIGS, Fort Gordon, with the missions and functions and phased personnel augmentation as set forth at Inclosure 1. The organizational relationships between the field office and the USASIGS task group are as indicated at Inclosure 3.

b. The Commandant, USASIGS, will:

(1) Provide appropriate facilities for the operational test in accordance with requirements established by the Product Manager.

(2) Coordinate with appropriate Fort Gordon activities to support the installation of the hardware/software system at Fort Gordon, as required by the Product Manager.

(3) Provide administrative support for the acceptance testing at Fort Gordon, as required by the Product Manager.

(4) Operate and maintain the hardware/software system after the final contract acceptance of the system by the Product Manager until the conclusion of the operational test and evaluation with the monitorship and advice of the Product Manager.

(5) Plan, program and budget additional system capacity not required by the operational test and evaluation. Any additional use of the system in this manner will be limited to Project ABACUS applications to be jointly concurred in. The Product Manager CTS will retain approval authority for recommended system use that is in addition to the test and evaluation.

(6) Accept full responsibility for the system established at Fort Gordon at the conclusion of the operational test and evaluation for use in accordance with TRADOC regulations in effect at that time.

(7) Provide the USASIGS Task Group leader and implementation staff as indicated at Inclosure 2 to conduct the course development and operational test of the prototype system.

(8) Prepare, conduct and administer the POI for the operational test and evaluation with the advice and monitorship of the Product Manager.

(9) Record evaluation data under specified training/testing conditions in the required format as designated by the Product Manager.

(10) Provide administrative working space for the PMO field liaison office and coordinate normal post support.

4. OTHER:

a. Funding: Product Manager, CTS, is responsible for programming and funding for FY 1975 and 1976 as pertains to: hardware and computer software acquisition and associated contract change orders, systems maintenance, interconnecting video and signal cables between the display controller and student terminals. The Commandant, USASIGS, will provide FY 75/76 O&MA funds for normal operating supplies, computer consumables, and magnetic devices (i.e., magnetic tape, discs, and disc packs). The Commandant will also provide for system operations and maintenance effective 1 July 1976.

b. Responsibilities for items not specifically covered in this Memorandum of Understanding will be resolved by mutual coordination.

c. This Memorandum of Understanding is subject to review and revision on the anniversary date of the Product Manager Charter or when major program changes are made by higher headquarters.

d. This Memorandum of Understanding is effective on date of signing by the Product Manager, CTS and Commandant, USASIGS.

G. B. HOWARD, COL
PRODUCT MANAGER, CTS

CHARLES R. MYER, MG
COMMANDANT, USASIGS

DATE 4 December 1974

DATE 13 January 1975

3 Incl
as